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Module 8

Mathematics 5

Volume, Capacity, Mass, and Time

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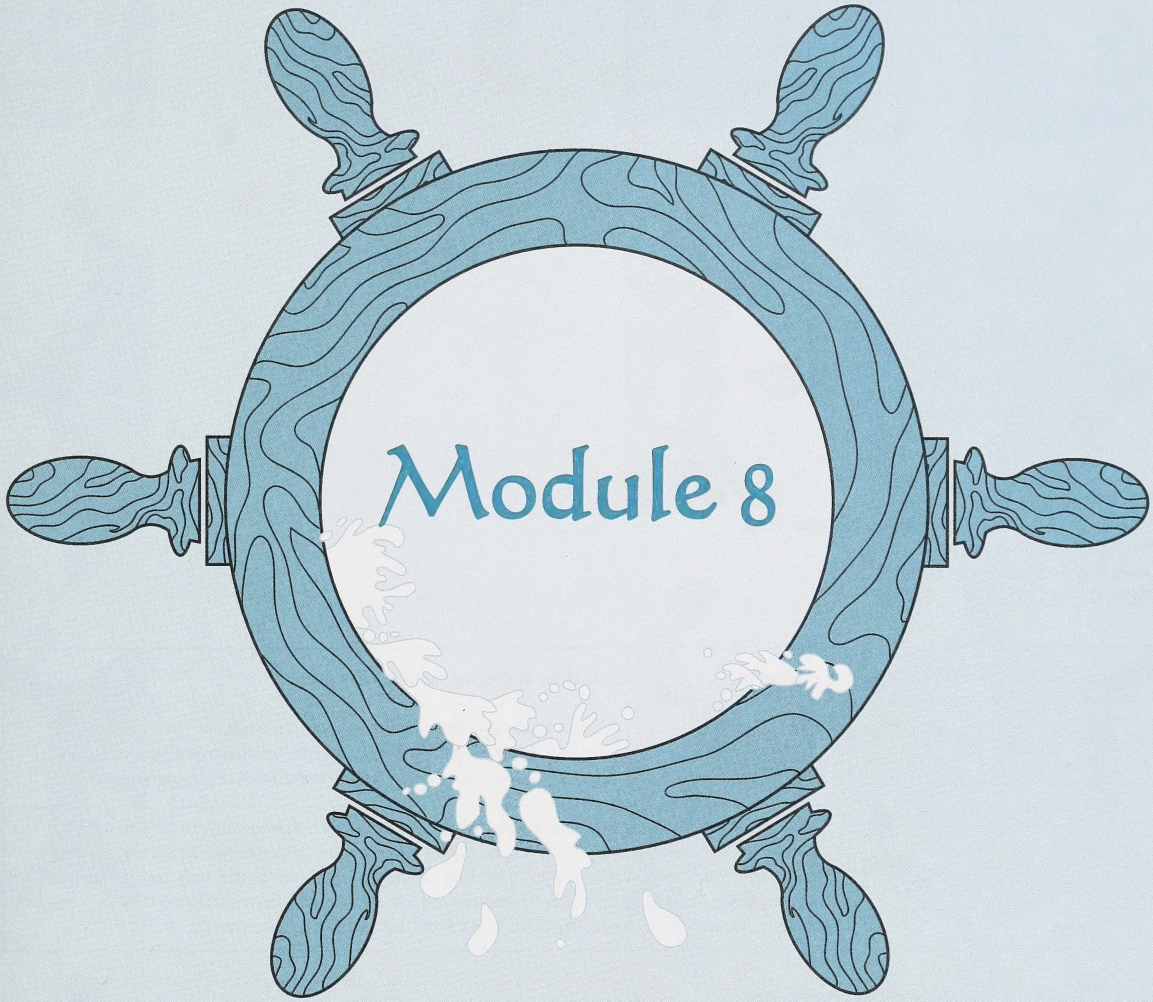
Mathematics 5



Volume, Capacity, Mass, and Time

Learning Technologies Branch

Alberta LEARNING

Mathematics 5
Module 8: Volume, Capacity, Mass, and Time
Student Module Booklet
Learning Technologies Branch
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Students	✓
Teachers	✓
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Home Instructors	
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Other	

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Welcome Aboard
Mathematics 5

Ahoy! Mathematics 5 contains nine modules.
You should work through the modules in order (from 1 to 9) because concepts and skills introduced in one module will be reinforced, extended, and applied in later modules.

Adventures on the High Seas

Kassidy: Connor, guess what? I noticed an advertisement in the newspaper. A second-hand bookshop just opened, and it's supposed to have some really old books from all over the world.

Connor: Some may even be older than our great-grandparents! Let's go take a look.

Excited about what they might find to read, Connor and Kassidy hurry off to the bookshop.

Connor: Wow! Look at this, Kassidy. Here's an actual journal kept by Captain Quinn almost 300 years ago. It's kind of musty, and parts are hard to read, but look at how much math the captain used!

Kassidy: There are also maps, descriptions of ships, and reports about sea conditions.

Connor: Let's buy it. Figuring out what the journal says will be like unravelling a mystery. Maybe it will have clues about real buried treasure.

From time to time throughout the course, you will work with many of the facts and figures about the days of sailing boats and sea captains that Kassidy and Connor discover.

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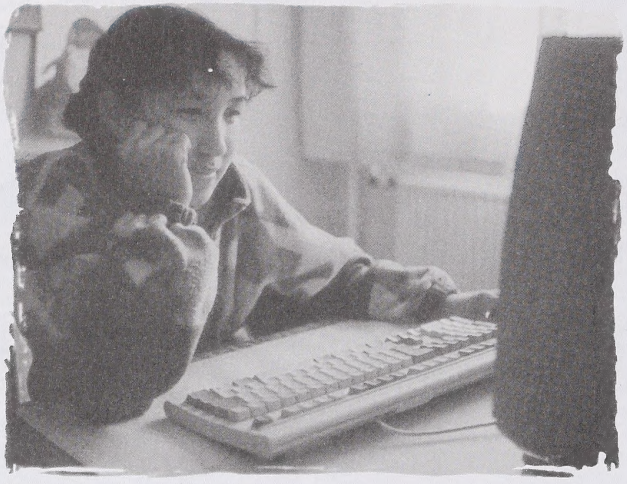
Course Features



BRYAN AND CHERRY ALEXANDER PHOTOGRAPHY

Take the time to look through the Student Module Booklet and the Assignment Booklets and notice the following design features.

- Each module has a Module Overview, Module Summary, and Review.
- Each module has several lessons. Each lesson focuses on a big idea that is central to the topic being learned in the module.
- Each lesson has several activities. An activity in each lesson is related to the high seas adventure theme. The last activity in each lesson is a Challenge Activity.
- Each module has a Glossary and an Answer Key in the Appendix. In several modules there are also special pull-out pages in the Appendix.
- Each module has special exercises that focus on certain mathematical skills. For example, The Numbers in the News project involves a scavenger hunt for samples of math in everyday life. The Keystrokes exercise introduces some "funky features" of the calculator that can be used to explore and practise important number ideas.

Required Resources

There are no spaces provided in the Student Module Booklets for your answers. This means you will need a binder and loose-leaf paper or a notebook to do your work.

In order to complete the course, you will need a copy of the Mathematics 5 textbook, *Quest 2000: Exploring Mathematics*, the soft-cover book *Quest 2000: Exploring Mathematics: Practice and Homework Book*, a basic four-operation calculator (such as the TI-108 calculator), and various manipulatives (base ten blocks and pattern blocks).

If you wish to complete the optional computer activities, you must have access to a computer that is connected to the Internet.

Visual Cues

For your convenience, the most important mathematical rules and definitions are highlighted. Icons are also used as visual cues. Each icon tells you to do something.

Use your calculator.

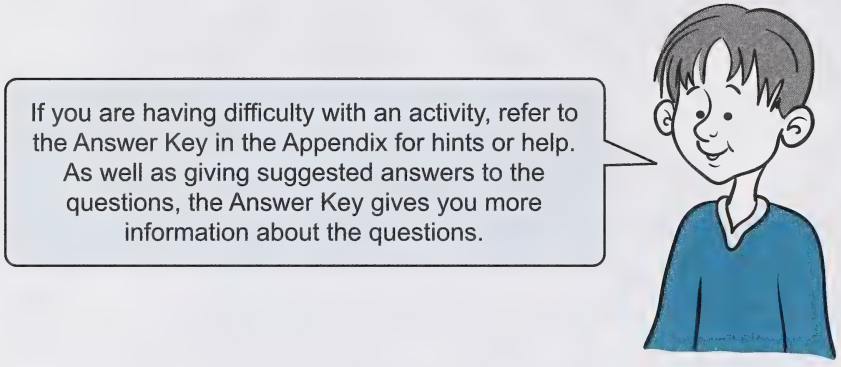
Use the Internet.

Refer to the textbook or the Practice and Homework Book.

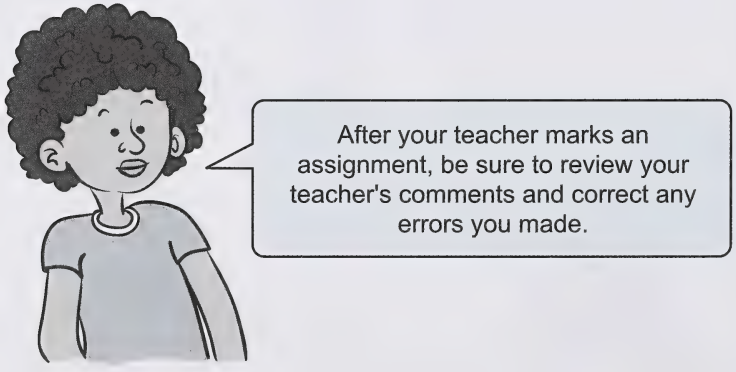
Your guides for this course are Kassidy and Connor.

Assessment and Feedback

The Mathematics 5 course is carefully designed to give you many opportunities to discover how well you are doing. In every activity you will be asked to turn to the Appendix to check your answers. Completing the activities and comparing your answers to the suggested answers in the Appendix will help you better understand math concepts, develop math skills, and improve your ability to communicate mathematically and solve problems.


If you are having difficulty with an activity, refer to the Answer Key in the Appendix for hints or help. As well as giving suggested answers to the questions, the Answer Key gives you more information about the questions.

Twice in each module you will be asked to give your teacher your completed assignments to mark. Your teacher will give you feedback on how you are doing.

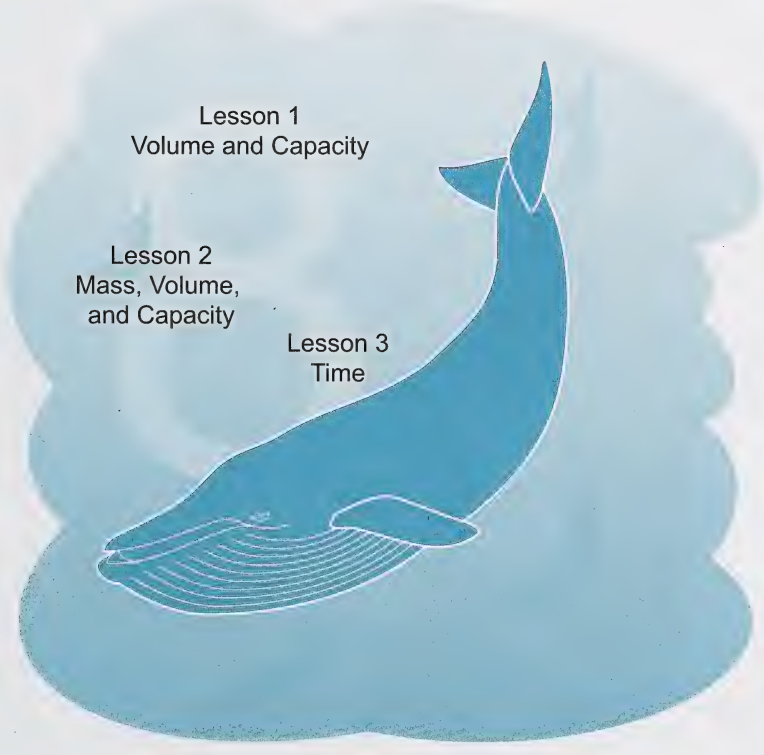


There will be a final test at the end of the course. You can prepare for the final test by completing the Review at the end of each module.

Module Overview

The largest animal in the world is the blue whale. A newborn calf measures about 7 m and has a mass of 3 t. The calf can drink up to 600 L of milk a day and doubles its mass in a week. An average adult blue whale is 25 m long and has a mass of 120 t. It may surprise you to discover that the tongue of a full-grown blue whale is as heavy as a full-grown African elephant, and the blue whale's heart is the size of a small car!

The three lessons in this module will extend your understanding of volume, capacity, mass, and time. You will develop methods for finding the volume of rectangular solids. You will use grams (g), kilograms (kg), and tonnes (t) to measure mass. You will discover how capacity is related to volume and mass. You will be introduced to the 24-h clock and standard international (SI) notations for dates and times. You will solve problems involving volume, capacity, mass, and time.



Your mark on this module will be determined by how well you complete the two Assignment Booklets.

The mark distribution is as follows:

Assignment Booklet 8A

Lesson 1 Assignment	30 marks
Lesson 2 Assignment	30 marks

Assignment Booklet 8B

Lesson 3 Assignment	30 marks
Numbers in the News	10 marks
Total	100 marks

When doing the assignments, work slowly and carefully. Be sure you attempt each part of the assignments. If you are having difficulty, you may use your course materials to help you, but you must do the assignments by yourself.

You will submit Assignment Booklet 8A to your teacher before you begin Lesson 3. You will submit Assignment Booklet 8B to your teacher at the end of this module.

Numbers in the News

Numbers are everywhere! Newspapers and magazines are full of stories and advertisements that show how numbers are used every day.

The following Scavenger Hunt asks you to look through newspapers and magazines for samples of number ideas like those you will be using in this module. Read through the list now and begin by collecting samples of the ideas you already understand. You may collect other samples as you learn about them in the module. Collect as many samples as you wish.

Scavenger Hunt

Cut out samples of each of the following number concepts from newspapers, flyers, and magazines.

1. measure of volume given in cm^3, dm^3, or m^3
2. measure of capacity given in mL or L
3. measures of mass given in g, kg, or t
4. times written in 12-h notation or 24-h notation
5. duration of time stated in hours and/or minutes and/or seconds
6. dates written in everyday notation or SI (metric) notation

You will find further instructions for submitting your project in Assignment Booklet 8B.

Lesson 1

Volume and Capacity

Have you ever wondered how people decide on the packaging materials for shipping? Box designers have to consider the space the box will take up, how much the box will hold, how sturdy the box should be, how easily it will stack, and where the pictures and print will go on the box.

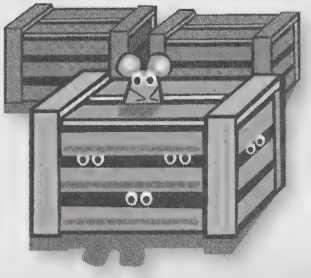
The boxes in the photograph are rectangular solids. What other shapes of boxes have you seen?

In this lesson you will develop methods to find the volume of a rectangular solid. You will construct rectangular solids with specific volumes. You will discover how volume and capacity are related, and you will use this relationship to solve problems.

Activity 1

Today you will estimate and find the volume of rectangular solids. You will also compare and order the volumes of different rectangular solids.

In the hold of my ship there are many treasures: gold, sugar, exotic spices, and fine silks. The treasure is stored in hundreds of chests, barrels, and crates. The mice have become such a problem that the crew has decided to get a cat.
-Captain Quinn



Some of the wooden crates and chests that Captain Quinn used were **rectangular solids**.

A rectangular solid is a three-dimensional object with flat faces that are rectangles.

Turn to page 251 of the textbook and look at the four rectangular solids shown there. These solids were made from 1-cm grid paper. Suppose the solids were made with **centimetre cubes**, sometimes called **centicubes**. To find the **volume** of these solids, you can count the cubes.

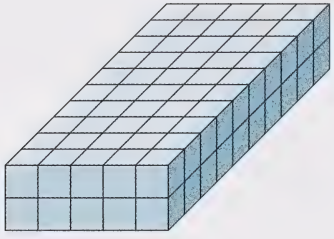
The amount of space occupied by an object is its volume. Volume is measured in cubic units.

Example

Look at the yellow solid on page 251 in the textbook. What is its volume? The solid is made of centimetre cubes. Each layer is a 2 by 5 array. This means that each layer has $2 \times 5 = 10$ cubes. Since there are ten layers, the yellow solid has $10 \times 10 = 100$ cubes. A centimetre cube has a volume of 1 cm^3, so the yellow solid has a volume of 100 cm^3.

Note: cm^3 is read as "cubic centimetre(s)"

If you pick up the yellow solid and set it down as shown below, will the volume remain the same? Each layer of the solid has $5 \times 10 = 50$ cubes. There are two layers in the solid, so there are $2 \times 50 = 100$ cubes in total. Each centimetre cube has a volume of 1 cm^3, so the yellow solid has a volume of 100 cm^3. The volume remains the same.



1. **a.** Make a model of each of the other three rectangular solids shown on page 251 of the textbook. Then find the volume of each.

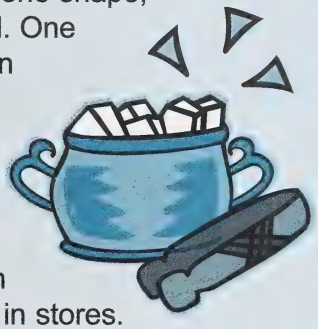
   b. Pick up each rectangular solid you made and confirm that the volume remains the same when you set the solid down on a different face.

2. List the four rectangular solids on page 251 of the textbook in order from least volume to greatest volume. Use the "less than" symbol (<).

Check your answers on pages 64 to 67 in the Appendix.

Captain Quinn wrote in his journal that there were many treasures in the hold of his ship: sugar, exotic spices, fine silks, and gold. Were you surprised to discover that sugar was considered a treasure? Following is an interesting story about sugar.

At first sugar was moulded and sold in a solid cone shape, and chunks of sugar were sawed off as needed. One day, the wife of the director of a sugar refinery in Eastern Europe cut her finger when she was cutting off some of the sweetener. She complained to her husband that sugar should be cut into smaller pieces. Her husband took up the challenge, and, in the autumn of 1841, presented his wife with a box of sugar cubes. In 1843, sugar cubes made their first appearance in stores. The idea soon caught on around the world.



3. Turn to page 248 of the textbook and look at the box that is closest to the top of the page.

   a. How many sugar cubes fit in the top layer of the box?

   b. How many layers of sugar cubes will fit in the box?

   c. If each sugar cube is 1 cm^3, what is the volume of the box?

   d. What are the length, width, and height of the box? Draw a picture of the box and label the dimensions (length, width, and height).

4. Look at the next lower box on page 248 of the textbook.

   a. How many sugar cubes fit in the top layer of the box?

   b. How many layers of sugar cubes will fit in the box?

   c. If each sugar cube is 1 cm^3, what is the volume of the box?

   d. What are the length, width, and height of the box? Draw a picture of the box and label the dimensions (length, width, and height).

5. Look at the next lower box on page 248 of the textbook.

   a. How many sugar cubes fit in the top layer of the box?

   b. How many layers of sugar cubes will fit in the box?

   c. If each sugar cube is 1 cm^3, what is the volume of the box?

   d. What are the length, width, and height of the box? Draw a picture of the box and label the dimensions (length, width, and height).

6. Look at the bottom box on page 248 of the textbook.

   a. How many sugar cubes fit in the top layer of the box?

   b. How many layers of sugar cubes will fit in the box?

   c. If each sugar cube is 1 cm^3, what is the volume of the box?

   d. What are the length, width, and height of the box? Draw a picture of the box and label the dimensions (length, width, and height).

Check your answers on pages 67 and 68 in the Appendix.

7. Complete page 108 in the Practice and Homework Book. You will need the centimetre grid paper from the Appendix and the small cubes from a set of base ten blocks.

8. Turn to page 111 in the Practice and Homework Book and answer questions 2, 4, and 6.

Check your answers on pages 68 and 69 in the Appendix.

Sharing Time

Now it's time to discuss what you have been learning with your home instructor.

Turn to page 109 in the Practice and Homework Book and answer some of the questions.

Your home instructor will help you check your answers.

Activity 2

Today you will build rectangular solids with the same volume.

You will need the centicubes from a set of base ten blocks and the centimetre grid paper in the Appendix for this activity.

1. Turn to page 253 of the textbook and look at the three rectangular solids shown at the top of the page. Each of the solids was made with 12 cubes. Can you make another rectangular solid with 12 cubes? Don't include slides, flips, or turns of the ones shown.

2. **a.** Turn to page 110 of the Practice and Homework Book and complete questions 1 to 4.

   b. Now complete questions 5 to 8 on page 110 of the Practice and Homework Book.

3. Turn to page 252 in the textbook and answer questions 1 to 3 of On Your Own.

Check your answers on pages 69 to 71 in the Appendix.

4. Turn to page 254 of the textbook and answer questions 2, 4, 6, and 8 of Practise Your Skills. (**Note:** To find the volume, visualize how many centimetre cubes would fit in the bottom layer of the box, the number of layers there would be, and the total number of cubes that would fit in the box.)

Check your answers on page 71 in the Appendix.

Sharing Time

Now it's time to show your home instructor what you have been learning.

Turn to page 111 of the Practice and Homework Book and answer questions 7 to 10.

Your home instructor will help you check your answers.

Activity 3

Today you will discover how volume and capacity are related.

1. Get out of a set of base ten blocks and look at the different pieces. What is the volume of a flat? Explain.

2. Build a cube with ten flats by using one flat for each layer.

   a. Give the dimensions of the cube in centimetres.
   b. Find the volume of the cube in cubic centimetres.
   c. Give the dimensions of the cube in decimetres.
   d. Find the volume of the cube in cubic decimetres.
   e. How are cubic centimetres related to cubic decimetres?

3. Trade each of the ten flats you used for the cube in question 2 for 100 centicubes. Then use all the centicubes to make as many different rectangular solids as possible.

   a. List the dimensions of all possible rectangular solids.

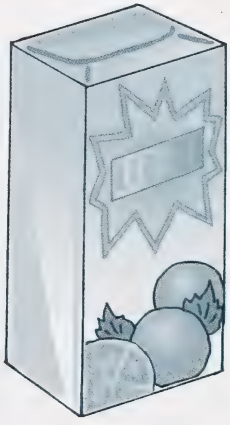
b. Do the solids still have a volume of 1 dm^3? Explain.

c. Does 1 dm^3 have to be in the shape of a cube? Explain.

Check your answers on pages 71 and 72 in the Appendix.

Capacity is the amount a container can hold. Common units of capacity in the metric system are the litre (L) and the millilitre (mL).

A container that has a volume of 1 dm^3 has a capacity of 1 L = 1000 mL.



4. Explain why a container that has a volume of 1 cm^3 holds 1 mL.

5. Turn to page 254 in your textbook. Question 1 shows a box being built to hold 100 centicubes, with 20 centicubes in the bottom layer.

a. How many layers of centicubes would there be in total?

b. What would be the dimensions of the box?

c. Use centimetre grid paper to make a pattern of the box. Draw a picture of your pattern.

d. Cut, fold, and tape the pattern to make the box. What is the volume of the box?

e. What is the capacity of the box?

f. How would the dimensions of the box change if you kept the base the same but made it large enough to hold 1 L?

Check your answers on pages 72 and 73 in the Appendix.

6. **a.** Compare the shape of a 1-L milk carton with the shape of the cubic decimetre you made in question 2 and with the shape of the 1-L box you described in question 5.f.

Why do you think the shape of milk cartons are shaped the way they are?

b. What other things come in 1-L containers? Find some 1-L containers in your home and describe the shapes of them.

Check your answers on page 73 in the Appendix.

Challenge Activity

1. Doreen wanted to make eight cubes of JELL-O®. She decided to make cubes of equal sizes with 1 L of liquid JELL-O®.

a. What is the volume (in cubic centimetres) of each JELL-O® cube?

b. What are the dimensions of each JELL-O® cube?

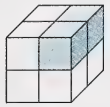
c. When Doreen poured the litre of liquid JELL-O® into a rectangular pan, the liquid rose to 1 cm below the top of the pan. The height of the pan was less than 12 cm.

What could have been the dimensions of Doreen's pan?

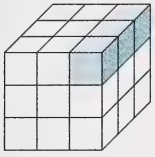
d. Which size of pan did Doreen most likely use?

Check your answers on pages 73 and 74 in the Appendix.

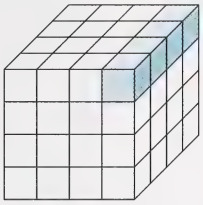
2. Rudy used centicubes to make the following three cubes. Then he removed the highlighted centicubes from the edge of each cube. (In other words, he removed 2 cubes from the first model, 3 cubes from the second model, and 4 cubes from the third model.)



$2 \times 2 \times 2$



$3 \times 3 \times 3$



$4 \times 4 \times 4$

Rudy used the remaining cubes from each model to make a rectangular solid.

In the following table, look for the pattern that is forming in each column.

Number of Centicubes on Each Edge of the Cube	Total Number of Centicubes in the Cube	Number of Centicubes After One Row Was Removed	Dimensions of One Rectangular Solid That Can Be Made with the Remaining Centicubes
2	$2 \times 2 \times 2 = 8$	$8 - 2 = 6$	1 cm $\times$ 2 cm $\times$ 3 cm
3	$3 \times 3 \times 3 = 27$	$27 - 3 = 24$	2 cm $\times$ 3 cm $\times$ 4 cm
4	$4 \times 4 \times 4 = 64$	$64 - 4 = 60$	3 cm $\times$ 4 cm $\times$ 5 cm
5			
6			
7			
8			

a. Describe how the column on the right is related to the column on the left.

b. Now, copy and complete the table by doing the following:

- Use your calculator to find the total number of centicubes in each cube.
- Remove one edge of centicubes from the cube.
- Predict the dimensions of the rectangular solid.
- Use your calculator to verify your results. (You may also verify by using centicubes to build a cube, take off an edge, and form the rectangular solid.)

c. Now use the patttern you discovered in question 2 to predict the dimensions of the rectangular solids that can be made by taking the edge off cubes that have edges of 25 centicubes, 56 centicubes, and 128 centicubes.

Check your answers on pages 74 and 75 in the Appendix.

Conclusion

In this lesson you developed a method to find the volume of rectangular solids. You constructed rectangular solids with specific volumes. You discovered how volume and capacity are related, and you used this relationship to solve problems.

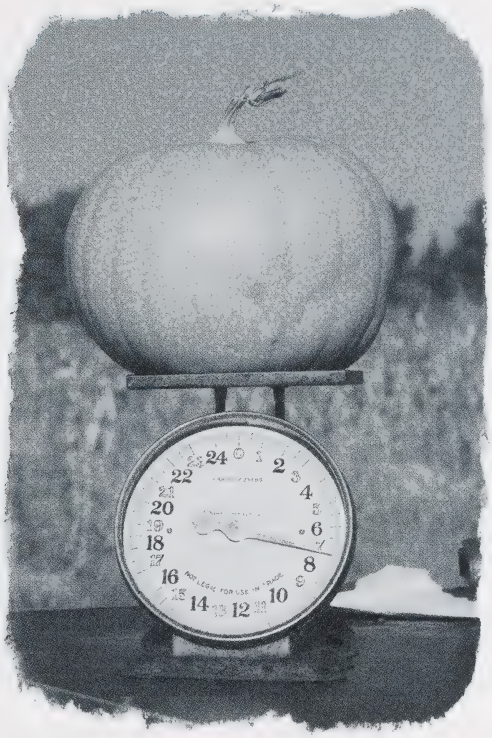
Pizza boxes are rectangular solids. What things did the box designers have to consider when they designed pizza boxes?

Turn to Assignment Booklet 8A and complete the Lesson 1 Assignment.

Keep Assignment Booklet 8A until you have completed the entire booklet.

Lesson 2

Mass, Volume, and Capacity



Did you know that pumpkins are believed to have originated in North America about 5000 years ago? Native Americans used to roast long strips of pumpkin on the open fire and eat them. When the first settlers arrived, they began to use pumpkins in a wide variety of recipes, from desserts to stews and soups.

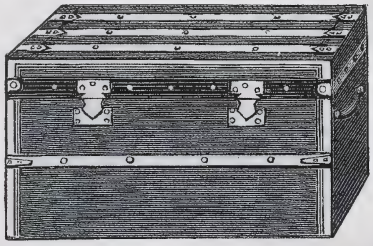
Today, there are pumpkin-growing contests in many communities. People compete to see who can grow the heaviest pumpkin. For example, Smoky Lake, Alberta, has a pumpkin "weigh-off" on the first Saturday in October each year.

In this lesson you will review the use of grams and kilograms when measuring mass. You will use tonnes to measure larger masses. You will discover how mass is related to volume and capacity.

Activity 1

Today you will use grams (g), kilograms (kg), and tonnes (t) to estimate and measure mass.

In the hold of my ship there are wooden chests filled with gold and silver bars. Silver is very heavy, and gold is twice as heavy as silver. Therefore, the ship's carpenters had to consider both the volume and the mass of the gold and silver bars when they built the chests.
-Captain Quinn



Suppose that each gold bar was a rectangular solid with the following dimensions: 10 cm long, 5 cm wide, and 2 cm deep. Use the rods from your set of base ten blocks to model several gold bars. (You may want to tape the rods together.)

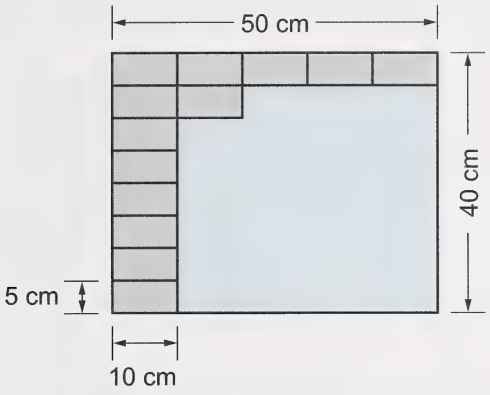
1. How many base ten rods do you need to model one gold bar?

Check your answer on page 75 in the Appendix.

The ship's carpenter made a chest to hold the gold bars. The inside of the chest was 50 cm long, 40 cm wide, and 20 cm deep. Make a model of the bottom of the empty chest by cutting a rectangle that is 50 cm long by 40 cm wide from a double page of newspaper.

Experiment with the models of the gold bars to find different arrays that will make a layer that covers the bottom of your chest. What you will discover will help you answer questions 2 to 9.

2. The following diagram shows one way you could begin making a bottom layer of bars in the chest. (Remember, the inside dimensions of the bottom of the chest are 50 cm by 40 cm.)



   a. Copy and complete the diagram in your notebook by showing all the bars on the bottom layer.

   b. How many gold bars are needed to make the bottom layer this way? Explain.

   c. What is the total number of such layers needed to fill the chest? Explain.

   d. How many gold bars are needed to fill the chest in this way? (Remember, the inside of the chest is 20 cm deep).

3. a. Draw an array that shows a different way to make a bottom layer of gold bars in the chest. (Remember, the inside dimensions of the bottom of the chest are 50 cm by 40 cm.)

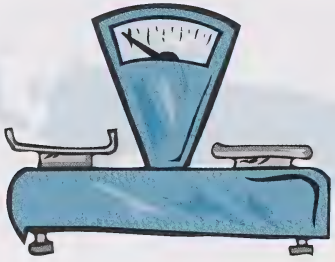
   b. How many gold bars are needed to make the bottom layer this way? Explain.

   c. What is the total number of such layers needed to fill the chest? (Remember, the inside of the chest is 20 cm deep.)

   d. How many gold bars are needed to fill the chest in this way? Explain.

4. Did you need the same number of gold bars to fill the chest in both questions 2 and 3?

Check your answers on pages 75 and 76 in the Appendix.



Mass is the amount of matter in an object. In the metric system, common units of mass are grams (g), kilograms (kg), and tonnes (t). Remember, 1 kg = 1000 g and 1 t = 1000 kg.

5. **a.** If 1 cm^3 of gold has a mass of 20 g, find the mass of one gold bar.

   b. If the chest is packed full with 400 gold bars, find the total mass of the gold bars in grams and in kilograms.

   c. Find the mass of the gold bars in tonnes.

   d. Two handles were fastened on opposite sides of the treasure chest so that it could be carried by two sailors. Do you think that two sailors could carry this chest of gold bars? Explain.

6. Suppose that each silver bar was the same length and width as a gold bar but twice as thick.

   a. Draw a picture of such a silver bar and label its dimensions.

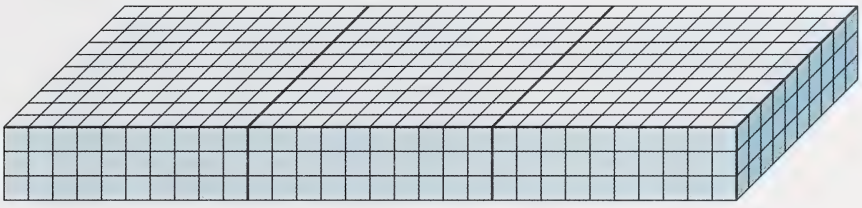
   b. If 1 cm^3 of silver has a mass of 10 g, find the mass of one silver bar.

   c. If the same chest was packed full with 200 silver bars, find the total mass of the silver bars in grams and in kilograms.

d. Do you think that two sailors could carry this chest of silver bars? Explain.

Check your answers on pages 76 and 77 in the Appendix.

Captain Quinn's carpenter wanted to cut oak planks to build a small chest that would hold gold and silver bars. The oak planks were 10 cm wide by 3 cm thick, and the total length needed was 6 m. To get an idea of the size of the planks, begin by making several piles of three base ten flats each, and place them end-to-end like this.



7. a. How many base ten flats would you need to represent a plank that is 6 m long? (Remember, $6\ \text{m} = 600\ \text{cm}$.)

b. If each cubic centimetre of oak has a mass of 0.4 g, about how heavy is the chest?

c. There were four layers of gold bars in the chest. Each layer was made up of 12 gold bars. Find the total mass of the chest and the gold bars.

d. Could two sailors carry this chest of gold bars?

e. To make the full chest lighter, half the gold bars were taken out and replaced with silver bars. Find the resulting total mass of the chest and the bars.

8. Captain Quinn's ship carried 240 silver bars and 365 gold bars in the hold. What is the total mass of the bars in tonnes? (Remember, each silver or gold bar has a mass of 2 kg.)

Check your answers on pages 77 and 78 in the Appendix.

Activity 2

Today you will solve problems involving mass using grams, kilograms, and tonnes.

Many food products are sold by mass. Use the information given in each of the following situations to solve the problems. You may use your calculator.

1. A box contains 144 sugar cubes arranged in two layers. The total mass of the sugar is 500 g.

a. Some of the sugar cubes are used, and the mass of the remaining cubes is 125 g. How many sugar cubes are left in the two-layer box?

b. Estimate the mass of one sugar cube to the nearest gram. Then use a calculator to find its mass to the nearest tenth of a gram.

c. You bought 3.25 kg of sugar cubes in bulk. Use a T-table to find the number of empty 500-g boxes you would need to hold the sugar cubes.

d. Find the number of sugar cubes there would be in 1 t of sugar cubes.

2. A storekeeper buys a 12-kg block of cheese that measures 30 cm by 36 cm by 10 cm.

a. Draw and label a picture of the block of cheese.

b. How many smaller blocks of cheese, each measuring 9 cm by 10 cm by 5 cm, can the storekeeper cut from the 12-kg block?

c. Find the mass, in grams, of each of the smaller blocks of cheese.

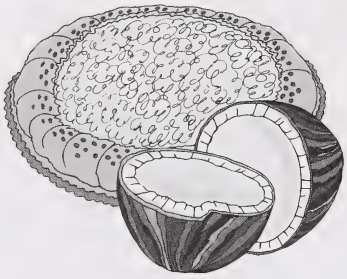
3. At a deli, ham costs $1.49 for each 100 g and chicken costs $1.29 for each 100 g.

a. Estimate and then find the exact total cost of 200 g of ham and 300 g of chicken.

b. Estimate and then find the exact cost of 0.5 kg of chicken.

c. There are 8 slices in 150 g of ham. Estimate and then find the mass of each slice of ham.

4. Simon bought a 1-kg coconut cream pie at the bakery. If 8 people share the pie, find the mass, in grams, of each person's serving.



5. A bakery advertised a 1.5-kg cheesecake.

   a. Estimate and then use a calculator to find the number of 125-g servings that can be cut from the cake.

   b. There are 100 people at a banquet. Use a T-table to find the number of 1.5-kg cheesecakes needed so that each person can receive a 125-g serving.

6. A grocery distributor received 1 t of grapes and repackaged them into 400-g bags to distribute equally to 25 stores.

   a. How many 400-g bags of grapes can the distributor make?
   b. How many bags of grapes will each store receive?

Check your answers on pages 78 to 81 in the Appendix.

Going Further

You might want to complete this activity the next time you go to the grocery store. Fill a plastic bag until you estimate its mass to be the target amount. Check your estimates on the store's scale by weighing each bag of produce and recording its actual mass. Choose some other types of produce and/or other target masses to complete a chart like the one shown.

Produce	Estimated Mass	Actual Mass
Apples	1 kg	
Oranges	2 kg	
Potatoes	3 kg	
Tomatoes	0.5 kg	

What do you notice about your estimates?

Check your answers on page 81 in the Appendix.

Activity 3

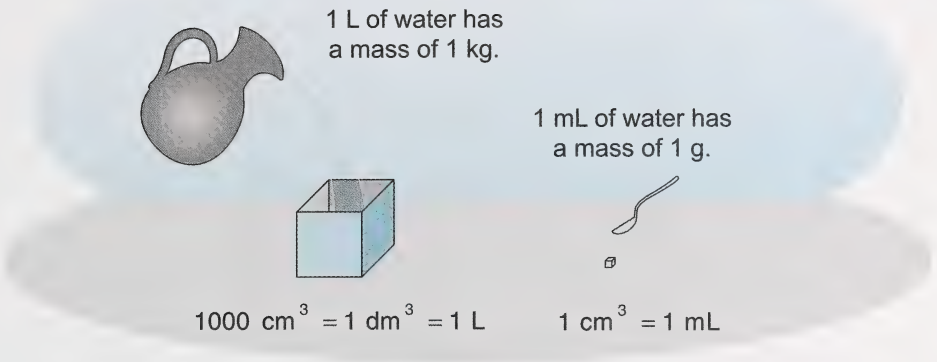
Today you will discover how volume, capacity, and mass are related.

Do you like to cook? If you do, you know that recipes list the ingredients needed to make a particular food dish. Sometimes the amounts needed are given in units of mass. At other times, the amounts needed are given in units of capacity.

In Lesson 1 you discovered how volume and capacity are related: 1 L occupies 1000 cm^3 or 1 dm^3. There are 1000 mL in 1 L, so $1\ cm^3 = 1\ mL$.

Now you will see how mass is related to volume and capacity. The mass of 1 dm^3 (1 L) of water is 1 kg. There are 1000 g in 1 kg, so the mass of $1\ cm^3$ $(1\ mL)$ of water $= 1\ g$.

The relationship between volume, capacity, and mass is illustrated in the following diagram.



To test this relationship, you will need a metric measuring cup to measure capacity, a metric scale to measure mass, and water.

1. a. Put the measuring cup on the scale and find the mass of the empty cup. Record the mass in your notebook.

b. What do you expect will be the mass of the cup filled with water? Explain.

c. Fill the cup with 250 mL of water, place it on the scale, and read its mass. Record the mass in your notebook.

d. Use your measurements to find the mass of the water in the cup. Explain.

e. Was your answer to question 1.d. what you expected? If not, explain why your results were different than you expected them to be.

Check your answers on page 82 in the Appendix.

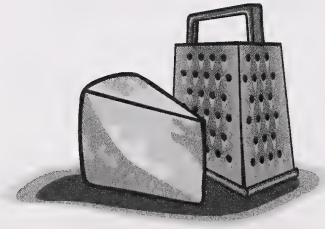
2. Will 1 L of any substance have a mass of 1 kg? To investigate this, you will need five different substances (flour, coffee, tea, sugar, rice, cereal, pasta, etc). Fill the measuring cup to the 250-mL mark with each substance. Predict whether it will be lighter or heavier than 250 mL of water, and then measure the mass in grams using your scale.

a. In your notebook, complete a chart like the one shown.

Substance (250 mL in a measuring cup)	Prediction	Mass (g)
Flour		
Sugar		
Dry Cereal (e.g., corn flakes)		
Pastas		
Rice		

b. What do you notice about your results?

3. A recipe requires shredded cheddar cheese. Is it better to give the amount needed in grams or in millilitres? Explain.



Check your answers on page 82 in the Appendix.

4. **a.** Examine the labels on some packages and cans of food to see if the amount is given in units of capacity or in units of mass. Sort the products into two categories: products sold by capacity and products sold by mass.

You might wish to use a table like this to record your answers.

Products Sold by Capacity (L or mL)	Products Sold by Mass (g or kg)

b. In what way are the products sold by capacity alike? In what way are the products sold by mass alike?

5. A 300-g box of cereal measures 25 cm long by 20 cm wide by 6 cm thick.

a. Find the capacity of the box in millilitres. Explain.

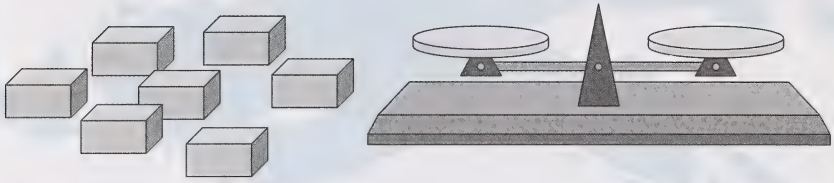
b. Use a calculator to find how many 25-g servings of cereal there are in a 300-g box.

c. Can you use the capacity of the box to find the capacity of a 25-g serving of cereal?

Check your answers on page 83 in the Appendix.

Challenge Activity

Pirate Pete switched one of these seven gold bars with a phony gold bar that was slightly lighter than a real one.



Explain two different ways you can use a balance scale to find the phony bar.

Check your answer on pages 83 and 84 in the Appendix.

Conclusion

In this lesson you reviewed the use of grams and kilograms when measuring mass. You used tonnes to measure larger masses. You explored how mass is related to volume and capacity, and you solved problems using units of grams, kilograms, and tonnes.

Turn to Assignment Booklet 8A and complete the Lesson 2 Assignment.

When you are done, send Assignment Booklet 8A to your distance learning teacher to be marked.

Lesson 3

Time

North Americans are generally very aware of time. Most people wear watches and have clocks in their homes, cars, and offices.

Have you ever noticed how time seems to pass quickly when you are doing something you find interesting, and how slowly time seems to pass when you are doing a chore you dislike? Have you ever wondered why most clocks show 12 hours when there are actually 24 hours in a day?

In this lesson you will use of the abbreviations **A.M.** and **P.M.** for reading and writing time on a 12-h clock. You will be introduced to the 24-h clock and international standard (SI) notations for writing dates and times. You will solve problems involving time.

Activity 1

Today you will investigate devices for telling time.

Sandglasses are essential items on our ship. We use them to time the length of sailors' duty watches. To find the speed of the ship, we use a sandglass and a spool of knotted rope called the log-line.

-Captain Quinn

Keeping track of time at sea was a challenge. One of a cabin boy's duties was to watch a 30-min sandglass. As soon as the last of the sand had run through the sandglass, he had to turn it over and ring the ship's bell.

The symbol for hour is h. The symbol for minutes is min. The symbol for second is s.

1. Sailors worked 4-h shifts called watches. The first watch of the day began at midnight. How many watches were there in one day?

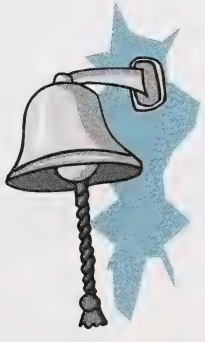
2. The bells repeat the following pattern during every 4-h watch:

Number of Hours into a 4-h Watch	Number of Bells Heard During a 4-h Watch
0.5	1
1	2
1.5	3
2	4
2.5	5
3	6
3.5	7
4	8

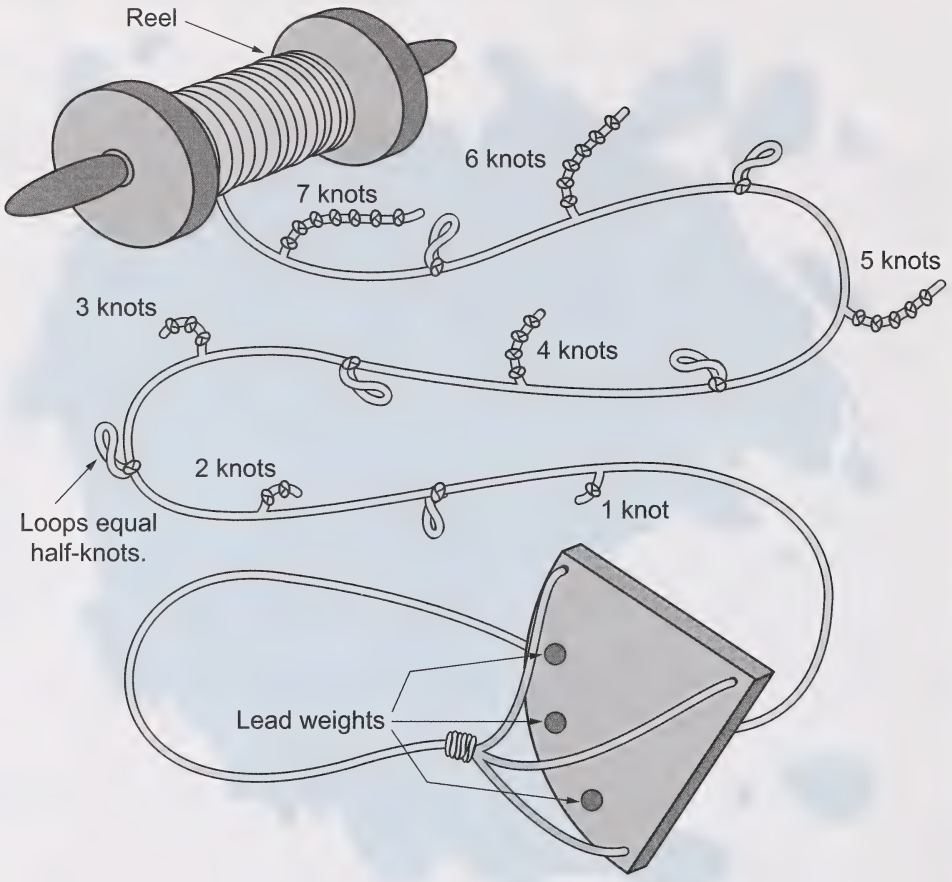
a. Find the total number of times a bell is heard during one 4-h watch.
b. Find the total number of times a bell is heard in one day.

Check your answers on pages 84 and 85 in the Appendix.

Each time the bells rang, the sailors measured the speed of the ship in "knots." They used a log-line, a piece of wood tied to a long rope with knots evenly spaced about 14 m apart. A sailor threw the log-line overboard and counted the number of knots that ran through his fingers in 30 s. The time was measured by using a 30-s sandglass.



Following is a picture of a log-line.



3. A sailor counted 5 knots in 30 s.

a. How many metres did the ship sail in 30 s?

b. How many kilometres did the ship sail if it travelled at the same speed for 1 h?

Check your answers on page 85 in the Appendix.

In Captain Quinn's day, a sandglass was used to measure time.

Later, **analogue clocks** became popular.

An analogue clock is a clock with hands.

An analogue clock usually has 60 subdivisions for the 60 minutes in one hour, so you can read the clock to the nearest minute.

Example

The time is read as "thirteen minutes after eight" or "eight thirteen."

The time is written as 8:13.

The time on this clock is read as "eight minutes before eight" or "seven fifty-two."

The time is written as 7:52.

4. Read the times shown on each of the following clocks. Then write the times shown on each clock.

a.

b.

c.

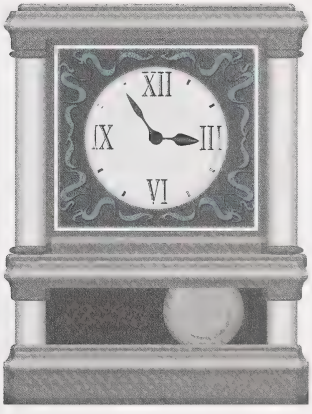
d.

e.

f.

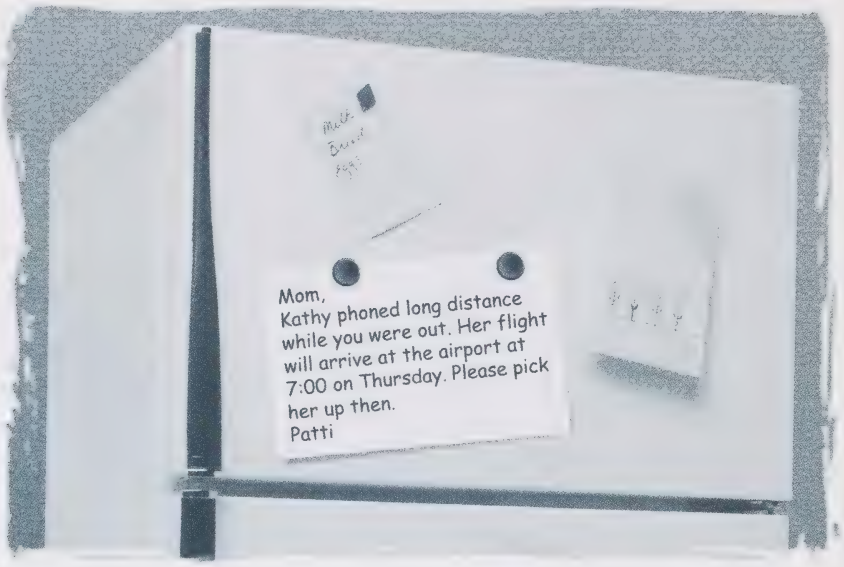
Check your answer on page 85 in the Appendix.

The numerals on some analogue clocks are Roman numerals.



Activity 2

Today you will read and write time on the 24-h clock.


Mom,
Kathy phoned long distance while you were out. Her flight will arrive at the airport at 7:00 on Thursday. Please pick her up then.
Patti

1. What is the problem with Patti's note to her mom?

Check your answer on page 85 in the Appendix.

Because there are 24 h in a day, the hour hand on a 12-h clock makes two full turns each day. To avoid confusion, the labels **A.M.** and **P.M.** are used.

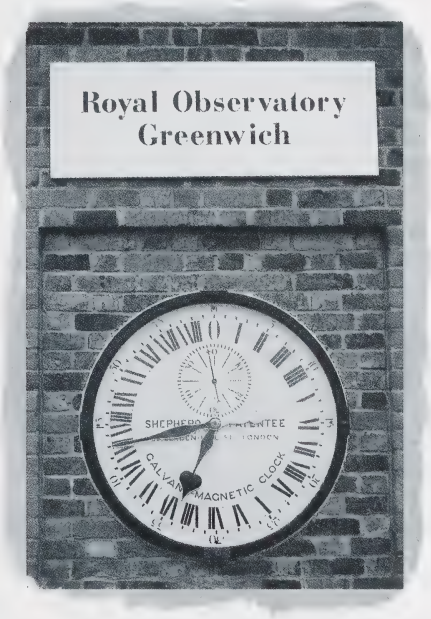
Remember, **A.M.** starts at midnight and continues until noon. **P.M.** starts at noon and continues until midnight.

2. Turn to page 106 of the textbook and look at the pictures. What's wrong with these pictures? Explain.

Check your answer on page 86 in the Appendix.

A day has 24 h, so a clock that shows 24 h instead of only 12 h makes sense!

In the fifteenth century, Greenwich, England, was established as the home of world time to help seafarers like Captain Quinn navigate the seas. The following picture shows the 24-h clock that was installed in 1852 outside the Royal Observatory at Greenwich. The clock hands are controlled by the master clock inside the observatory.

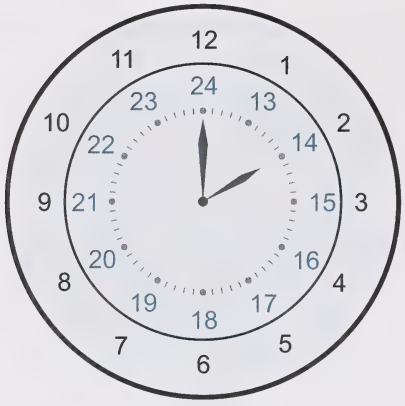


Today, 24-h time is used around the world in airports, train stations, bus depots, and shipyards to track arrivals and departures. It is used in hospitals to time medications, in universities for class timetables, and in business for shift schedules.

As there is no need to use A.M. or P.M., 24-h time provides clear communication that prevents confusing messages, such as in Patti's note to her mom.

Because every day begins and ends at midnight, the problem is how to represent midnight. In 12-h time, it is written as 12:00 A.M.; and in 24-h time, it is usually written as 00:00. In 24-h time, two digits are used for the hours and two digits are used for the minutes.

One way to relate 24-h time to 12-h time is to show two numbers at each hour position on a regular 12-h clock face.



3. Use the clock face shown above to help you complete a table like the following by filling in the missing 12-h and 24-h times.

12-h Time	24-h Time
12:00 A.M. (midnight)	00:00
1:00 A.M.	01:00
2:00 A.M.	02:00
3:00 A.M.	
4:00 A.M.	04:00
	05:00
6:00 A.M.	
	07:00
8:00 A.M.	
10:00 A.M.	10:00
	11:00

12-h Time	24-h Time
12:00 P.M. (noon)	12:00
	13:00
2:00 P.M.	
	15:00
4:00 P.M.	
5:00 P.M.	
	18:00
7:00 P.M.	
8:00 P.M.	
	21:00
10:00 P.M.	
	23:00

4. Laura said that when she sees an afternoon time written in 24-h time, she just subtracts 12 h to write it in 12-h time. Is Laura's method correct? Explain.

5. Henri works at the bus depot. His job is to update the arrivals and departures schedule. Copy and complete the following table in your notebook to show the updated times.

Change to Be Made	12-h Time	24-h Time
3 h past 10:00 A.M.		
4 h before 11:30 A.M.		
5.5 h after 6:00 P.M.		
2 h before 15:15		
3 h 15 min after 08:45		
3.25 h past 8:45 P.M.		
12 h before 16:10		

Check your answers on page 86 in the Appendix.

6. A parade started at 09:20 and ended at 14:40. Find how long the parade lasted. Explain your method.

7. A hot-air balloon trip started at 8:20 **A.M.** and ended at 3:50 **P.M.** Find how long the balloon trip lasted. Explain your method.

8. Deepti's plane is scheduled to take off at 18:45. The time is currently 2:15 **P.M.** Find how much time Deepti has until take-off. Explain your method.

9. Six people were asked to keep track of their time spent logged on to the Internet on Tuesday. The times when they logged on and logged off are shown in the following table.

a. Copy and complete the table in your notebook.

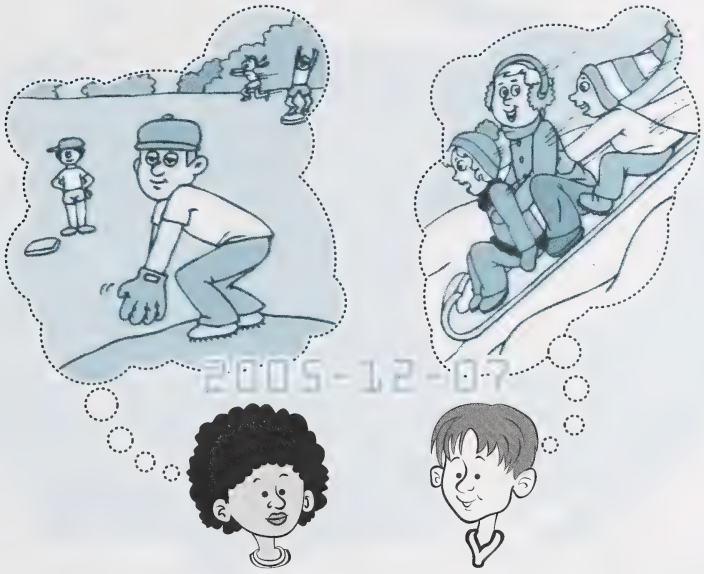
Person's Name	Starting Time (Logged On)	Ending Time (Logged Off)	Length of Time
Raoul	11:00	18:00	
Janine	8:00 A.M.	3:00 P.M.	
Sid	06:30	14:30	
Victoria	4:30 P.M.	8:30 P.M.	
Sasha	16:30	20:15	
Yasmin	10:45 A.M.	3:15 P.M.	

b. Do you find it easier to compare two times when they are written in 12-h notation or in 24-h notation? Explain.

Check your answers on pages 87 and 88 in the Appendix.

Activity 3

Today you will use SI (metric) notation for dates and times.



What does the date 2005-12-07 mean? Does it mean July 12, 2005, or does it mean December 7, 2005?

You will see dates written in a variety of ways:

- month, day, and year
- year, month, and day
- day, month, and year

To prevent confusion, the SI notation uses the following rules:

Dates are listed in the following order: **year**, then **month**, and then **day**. A hyphen is used as a separator.

Time is listed in the following order: **hour**, then **minute**, and then **second**. A colon is used as a separator.

1. How is the ordering of dates similar to the ordering of time?

2. Copy and complete the following table in your notebook.

SI Notation	Description of the Date and Time
2003-04-02 20:05	8:05 P.M. on April 2, 2003
1989-01-31 01:31	
	5:45 P.M. on September 19, 1991
1992-08-01 05:16	
2001-01-08 16:05	
	11:05 P.M. on June 29, 1996
1998-06-24 00:00	
	2:02 A.M. on February 2, 2002

3. On 2004-05-15, Garry received an invitation from his cousins. They asked him to go to the mountains with them on 2004-07-23. How long must Garry wait until the trip?

4. Suzie looked at the calendar and saw that the date was 2003-05-17. She said that she will be ten years old in 3 months and 12 days.

   a. Use SI notation to write the date of Suzie's tenth birthday.
   b. Use SI notation to write the date when Suzie was born.

5. Use SI notation to write the date that is 6 months and 25 days after March 10, 2002.

6. On 1777-10-31 12:40, the ship docked at home port. Write this date and time in the everyday way (by naming the month and by using 12-h time).

Check your answers on page 89 in the Appendix.

Challenge Activity

Two clocks were set at 11:00. One of the clocks ran fast, gaining 10 min every hour. The other clock ran slow, losing 5 min every hour. What will the actual time be when the fast clock reads 2 h ahead of the slow clock?

Check your answer on page 90 in the Appendix.

Conclusion

In this lesson you reviewed the reading and writing of 12-h time. You learned to use a 24-h clock and used SI notation for writing dates and times. You solved problems involving time.

Turn to Assignment Booklet 8B and complete the Lesson 3 Assignment.

Keep Assignment Booklet 8B until you have completed the entire booklet.

Module Summary

In this module you extended your understanding of volume, capacity, mass, and time. You developed methods for finding the volumes of rectangular solids. You used grams (g), kilograms (kg), and tonnes (t) to measure mass. You discovered how capacity is related to volume and mass. You were introduced to the 24-h clock and SI notation for dates and times. You solved problems involving volume, capacity, mass, and time.

In the Module Overview you read some interesting facts about the blue whale. You may wish to use the library or the Internet to learn more about blue whales. How does the size of a blue whale compare to the size of a dinosaur?

Turn to Assignment Booklet 8B and complete the Numbers in the News project.

When you are done, send Assignment Booklet 8B to your distance learning teacher to be marked.

Keystrokes

Take out your calculator and complete the following exercises. They will help you review some of the ideas you have learned in Module 8.

Funky Feature: What's Your Birth "Day"?

You can use this trick to find the day of the week (Sunday, Monday, Tuesday, etc.) a person was born on in any particular year (as long as they were born in the 1900s).

- Write the person's birth date using SI notation. For example, write September 19, 1991, as 1991-09-19.
- Enter the last two digits of the year and divide by 4.

Keystrokes	ON/C	91	÷	4	=
Display	0	91	91	4	22.75

- If the answer is not a whole number, take only the whole number part of the answer and re-enter it.

Keystrokes	ON/C	22
Display	0	22

- Add the last two digits of the year again.

Keystrokes	+	91	=
Display	22	91	113

- Add the day of the month the person was born on.

Keystrokes	+	19	=
Display	113	19	132

- Add the value of the month using the following table.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0	3	3	6	1	4	6	2	5	0	3	5

Keystrokes	+	5	=
Display	132	5	137

- Divide by 7 and note if the answer is a whole number or a decimal. If the answer is a whole number, the remainder is 0. If the answer is a decimal, find the remainder.

Keystrokes	÷	7	=
Display	137	7	19.571428

Keystrokes	ON/C	19	×	7	=
Display	0	19	19	7	133

$137 - 133 = 4$

The remainder is 4.

- Use the remainder and following table to find the day of the week the person was born on.

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
0	1	2	3	4	5	6

- 1991-09-19 was a Thursday!

1. On what day of the week was August 1, 1992?

2. On what day of the week were you born?

Check your answers on page 90 in the Appendix.

Review

This review will help you apply what you learned in Module 8 and prepare for the final test. Discuss with your home instructor when you should begin the Review and how much of the Review you should complete.

1. Choose three different cracker boxes or cookie boxes that you have at home.

   a. Estimate the volume of each box in cubic centimetres. Order the boxes according to your estimate.

   b. Explain how you can use centicubes or a ruler to check your estimates.

2. Turn to page 256 of your textbook.

   a. Do questions 1, 2, and 3 of Practise Your Skills. Explain your answers.

   b. Which of the boxes shown on page 256 have a capacity of 1 L? Explain.

Check your answers on pages 91 to 93 in the Appendix.

If you need help with questions 1 and 2, look back at Lesson 1, where you learned about the volume and capacity of rectangular solids. If you feel you need more practice, do questions 3 and 4.

3. Turn to page 252 of your textbook. Do questions 1 and 2 of Practise Your Skills.

4. Turn to page 264 of your textbook. Do questions 2, 4, and 5 of Skill Bank from This Unit.

Check your answers on pages 93 and 94 in the Appendix.

5. A small gold bar is 2 cm by 4 cm by 5 cm.

   a. If 1 cm^3 of gold has a mass of 20 g, find the mass of the gold bar in grams and in kilograms.

   b. Find how many of these gold bars there would be in 1 t.

6. Find how many kilograms of hamburger you would need to make 3 dozen hamburgers if each hamburger patty has a mass of 100 g.

7. The label on a bottle of water lists its capacity as 341 mL. If the empty bottle has a mass of 50 g, find the mass of the bottle when it is full of water.

Check your answers on pages 94 and 95 in the Appendix.

If you need help with questions 5, 6, and 7, look back at Lesson 2, where you learned how mass is related to volume and capacity. If you feel you need more practice, do questions 8 to 10.

8. A 42-link gold chain has a mass of 525 g.

   a. Find the mass of one link.
   b. Find how many links there would be in a 1-kg chain.

9. A deli sandwich contains 75 g of shaved ham. Find how many of these sandwiches can be made from 1.2 kg of shaved ham.

10. A recipe calls for 275 mL of water. Explain how you could use a kitchen scale to measure the water.

Check your answers on page 95 in the Appendix.

11. Copy and complete the following table in your notebook by filling in the 12-h and 24-h times.

Description of Time	12-h Time	24-h Time
10 min past 13:25		
5 min before 12:00 noon		
2 h after 22:55		
4 h 10 min before 9:16 P.M.		
1 second past midnight		

12. Donna was born on March 29, 1995. Write the date of her tenth birthday using SI notation.

13. Sunrise on December 18, 2000, was at 8:47 **A.M.** Write this date and time using SI notation.

Check your answers on pages 95 and 96 in the Appendix.

If you need help with questions 11, 12, and 13, look back at Lesson 3, where you learned about 12-h time, 24-h time, and SI notation. If you feel you need more practice, do questions 14 and 15.

14. Give the 12-h time and the 24-h time for each of the following.

a. 15 min past 15:30
b. 1 h 5 min before 6:52 **A.M.**
c. 23 min after 23:40

15. Write the following dates and times using SI notation.

a. A plane departed from Calgary at 7:55 **A.M.** on November 15, 1999.

b. In a science fiction novel, a spaceship landed on Mars on May 30, 2020, at 8:15 **P.M.**

Check your answers on page 96 in the Appendix.

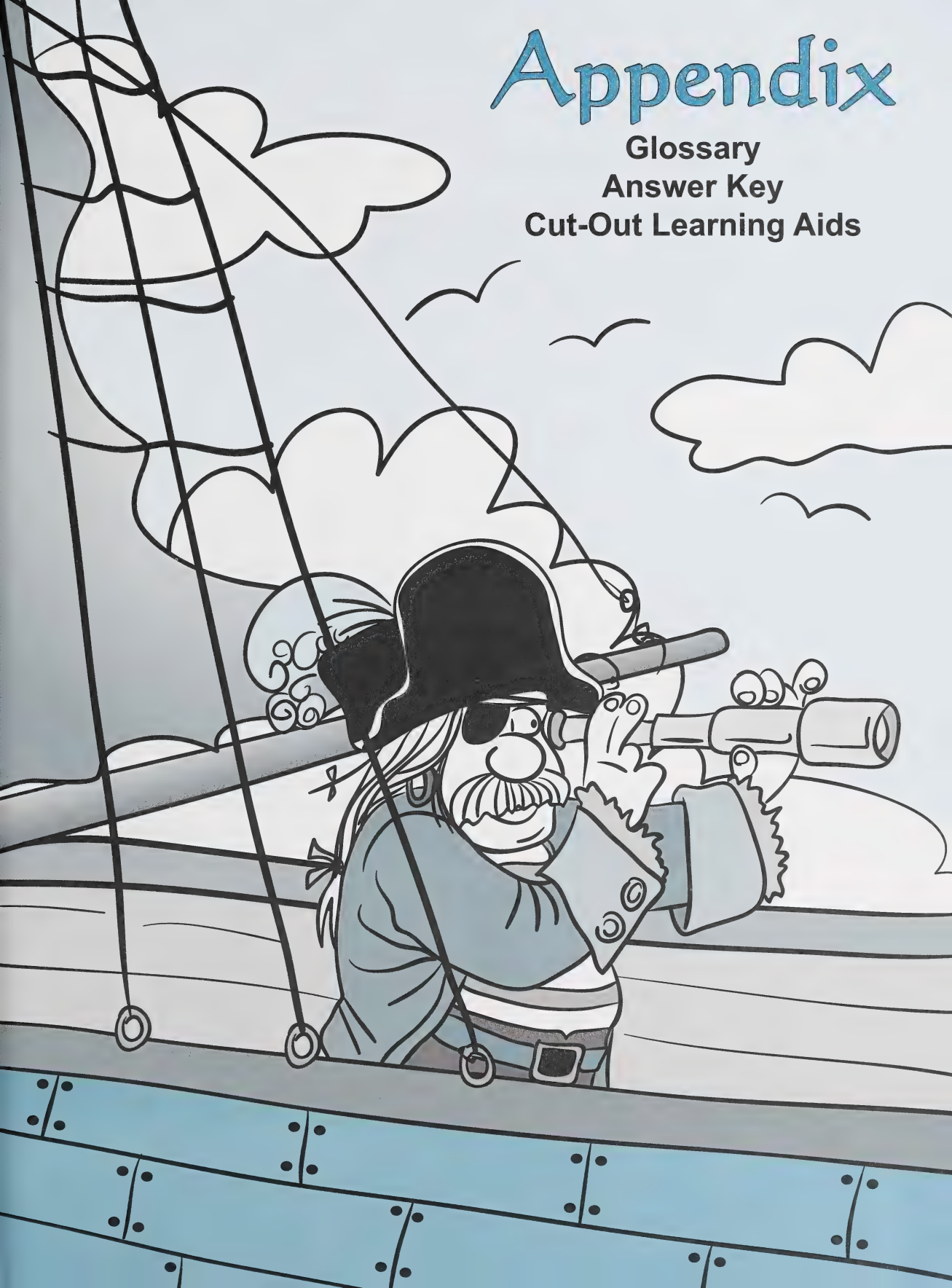
16. Turn to page 262 of your textbook. Do questions 1 and 3 from Problem Bank. Show your work for each problem.

Check your answers on pages 96 and 97 in the Appendix.

If you feel you need more practice solving problems, do question 17.

17. Turn to page 264 of your textbook. Do question 5 of Skill Bank from This Unit.

Check your answers on page 97 in the Appendix.



Appendix

Glossary
Answer Key
Cut-Out Learning Aids

Glossary

analogue clock: a clock with hands

capacity: the amount a container can hold

mass: the amount of matter in an object

rectangular solid: a three-dimensional object with flat faces that are rectangles

volume: the amount of space an object occupies

Answer Key

Lesson 1: Volume and Capacity

Activity 1

1. a. Blue solid

As it is standing in the picture, the blue solid has 7 layers of cubes. Each layer is a 4 by 5 array. This means that each layer has $4 \times 5 = 20$ cubes. Since there are 7 layers, the blue solid has a volume of $7 \times 20 = 140$ cubes. Each cube has a volume of 1 cm^3, so the volume of the blue solid is 140 cm^3.

Red solid

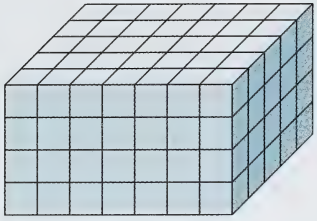
As it is standing in the picture, the red solid has 6 layers of cubes. Each layer is a 2 by 9 array. This means that each layer has $2 \times 9 = 18$ cubes. Since there are 6 layers, the red solid has a volume of $6 \times 18 = 108$ cubes. Each cube has a volume of 1 cm^3, so the volume of the red solid is 108 cm^3.

Purple solid

As it is standing in the picture, the purple solid has 2 layers of cubes. Each layer is a 3 by 11 array. This means that each layer has $3 \times 11 = 33$ cubes. Since there are 2 layers, the purple solid has a volume of $2 \times 33 = 66$ cubes. Each cube has a volume of 1 cm^3, so the volume of the purple solid is 66 cm^3.

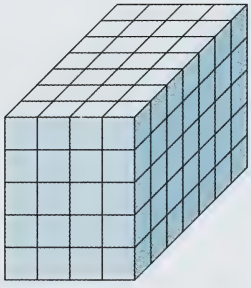
b. Blue solid

- If you set down the blue solid as shown below, it has 4 layers of cubes. Each layer is a 5 by 7 array.



This means that each layer has $5 \times 7 = 35$ cubes. Since there are 4 layers, the blue solid has a volume of $4 \times 35 = 140$ cubes $= 140$ cm^3.

- If you set down the blue solid as shown below, it has 5 layers of cubes. Each layer is a 4 by 7 array.

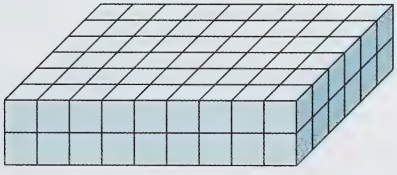


This means that each layer has $4 \times 7 = 28$ cubes. Since there are 5 layers, the blue solid has a volume of $5 \times 28 = 140$ cubes $= 140$ cm^3.

Yes, the volume remains the same.

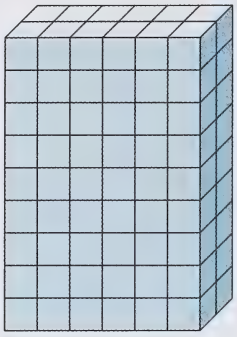
Red solid

- If you set down the red solid as shown below, it has 2 layers of cubes. Each layer is a 6 by 9 array.



This means that each layer has $6 \times 9 = 54$ cubes. Since there are 2 layers, the red solid has a volume of $2 \times 54 = 108$ cubes $= 108$ cm^3.

- If you set down the red solid as shown below, it has 9 layers of cubes. Each layer is a 2 by 6 array.

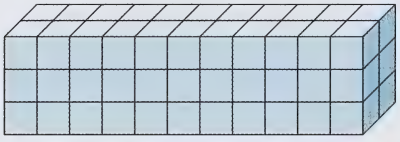


This means that each layer has $2 \times 6 = 12$ cubes. Since there are 9 layers, the red solid has a volume of $9 \times 12 = 108$ cubes $= 108$ cm^3.

Yes, the volume remains the same.

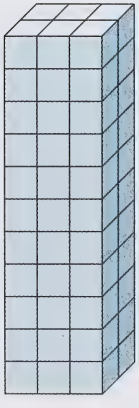
Purple solid

- If you set down the purple solid as shown below, it has 3 layers of cubes. Each layer is a 2 by 11 array.



This means that each layer has $2 \times 11 = 22$ cubes. Since there are 3 layers, the purple solid has a volume of $3 \times 22 = 66$ cubes $= 66$ cm^3.

- If you set down the purple solid as shown below, it has 11 layers of cubes. Each layer is a 2 by 3 array.



This means that each layer has $2 \times 3 = 6$ cubes. Since there are 11 layers, the purple solid has a volume of $11 \times 6 = 66$ cubes $= 66$ cm^3.

Yes, the volume remains the same.

2. purple bar < yellow bar < red bar < blue bar

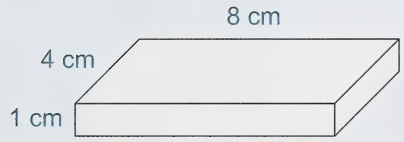
3. a. There are 4 rows of 8 cubes.

$4 \times 8 = 32$ cubes

b. Only one layer of sugar cubes will fit in the box.

c. The volume of the box is $32\ \text{cm}^3$.

d.



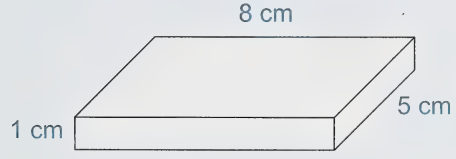
4. a. There are 5 rows of 8 cubes.

$5 \times 8 = 40$ cubes

b. Only one layer of sugar cubes will fit in the box.

c. The volume of the box is $40\ \text{cm}^3$.

d.



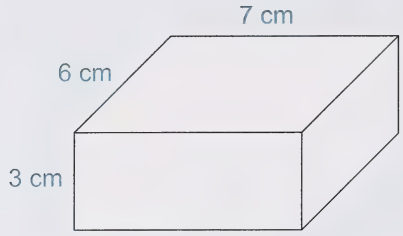
5. a. There are 6 rows of 7 cubes.

$6 \times 7 = 42$ cubes

b. Three layers of sugar cubes will fit in the box.

c. The volume is $3 \times 42 = 126\ \text{cm}^3$.

d.



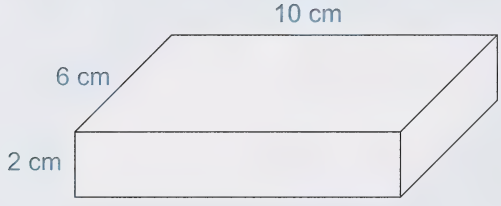
6. a. There are 6 rows of 10 cubes.

$6 \times 10 = 60$ cubes

b. Two layers of sugar cubes will fit in the box.

c. The volume is $2 \times 60 = 120 \text{ cm}^3$.

d.



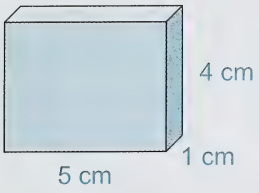
7. Practice and Homework Book, page 108

Box	Estimate	Number of Cubes	Volume
A	Answers will vary.	100	100 cm^3
B	Answers will vary.	128	128 cm^3
C	Answers will vary.	108	108 cm^3
D	Answers will vary.	64	64 cm^3

Box D < Box A < Box C < Box B

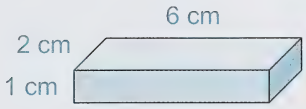
8. Practice and Homework Book, page 111, questions 2, 4, and 6

2.



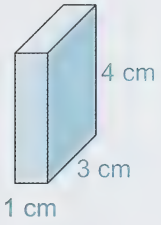
Volume = 20 cm^3

4.



Volume = 12 cm^3

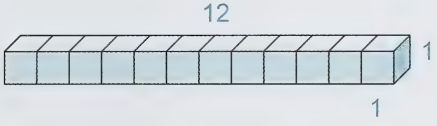
6.



Volume = 12 cm^3

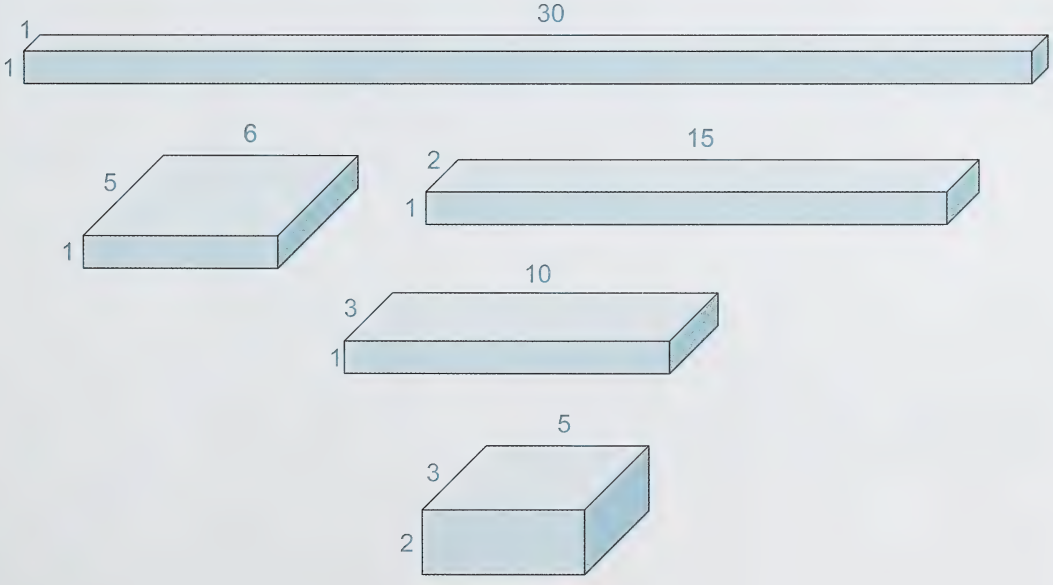
Activity 2

1. You can make the following rectangular solid with 12 cubes.



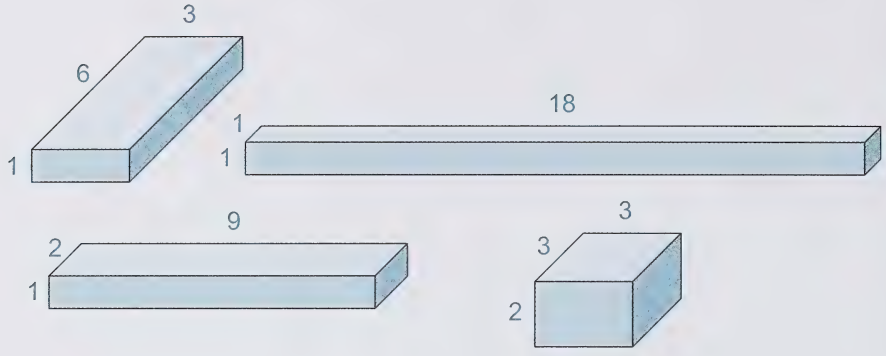
2. a. Practice and Homework Book, page 110, questions 1 to 4

You may have drawn any four of the following rectangular solids.



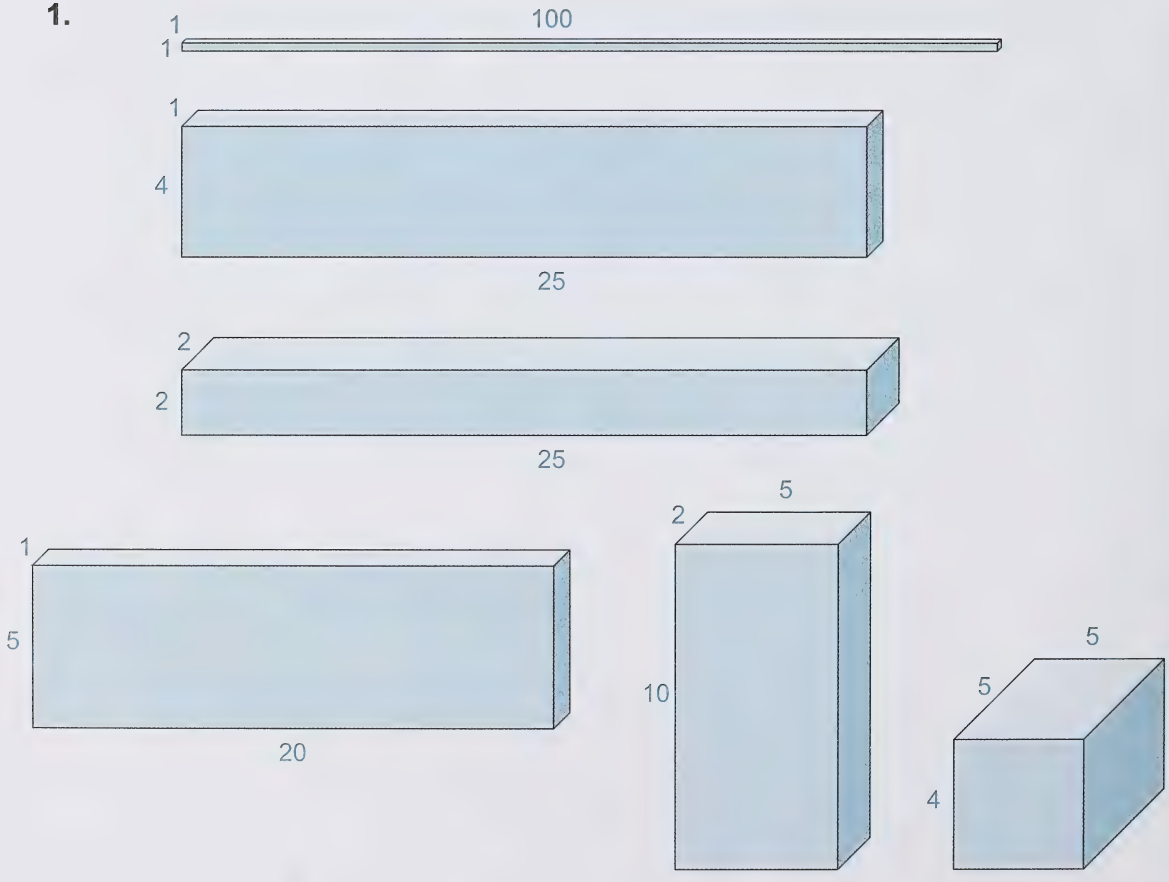
b. Practice and Homework Book, page 110, questions 5 to 8

You should have included the following drawings.

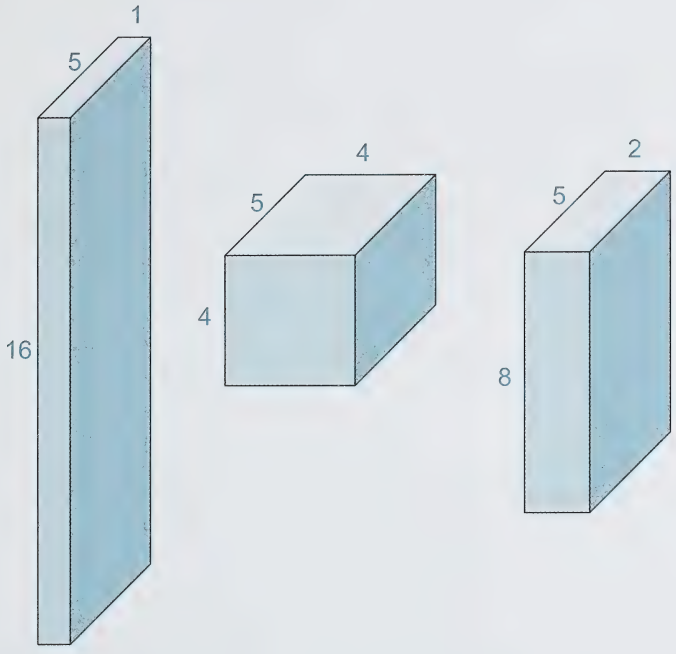


3. Textbook, page 252, On Your Own, questions 1 and 2

1.



2. Possible answers include the following:



3. No, the tallest box is not always the box with the greatest volume. A tall box holds more layers of centicubes than a short box, but a short box may have many more centicubes in each layer.

4. **Textbook, page 254, Practise Your Skills, questions 2, 4, 6, and 8**

2. $9 \times 12 \times 6 = 648 \text{ cm}^3$ **4.** $25 \times 20 \times 10 = 5000 \text{ cm}^3$

6. $12 \times 12 \times 12 = 1728 \text{ cm}^3$ **8.** $3 \times 6 \times 30 = 540 \text{ cm}^3$

Activity 3

1. One flat has a volume of 100 cm^3. It is made of 100 centicubes, each of which has a volume of 1 cm^3.

2. **a.** The cube has dimensions of 10 cm by 10 cm by 10 cm.
   b. The volume of the cube is 1000 cm^3.

c. The cube has dimensions of 1 dm by 1 dm by 1 dm.

d. The volume of the cube is 1 dm^3.

e. 1 $dm^3 = 1000\ cm^3$

3. a. The dimensions of the solids are

- 1 cm by 10 cm by 100 cm
- 1 cm by 20 cm by 50 cm
- 2 cm by 10 cm by 50 cm
- 5 cm by 10 cm by 20 cm

b. Yes, all the solids still have a volume of 1 dm^3. Each solid is made up of 1000 centicubes.

c. No, 1 dm^3 doesn't have to be in the shape of a cube. It can have any shape with a capacity of 1 L.

4. 1 L occupies 1 dm^3 or 1000 cm^3.

$1\ L = 1000\ mL$

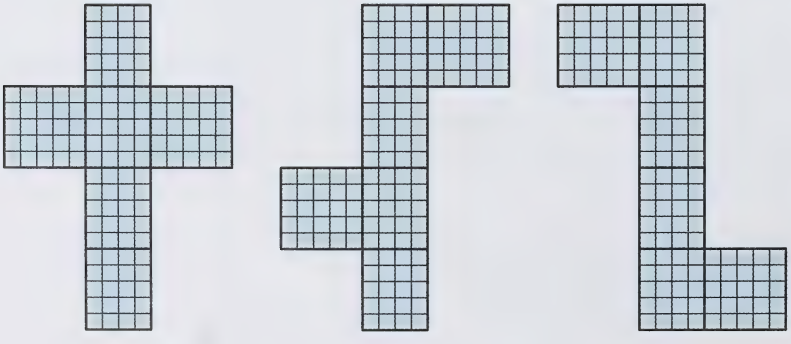
Therefore, $1000\ mL = 1000\ cm^3$

$1\ mL = 1\ cm^3$

5. a. There would be five layers.

b. The dimensions of the box would be 4 cm by 5 cm by 5 cm.

c.



d. The volume of the box is 100 cm^3. (It holds 100 centicubes, each of which has a volume of 1 cm^3.)

e. The capacity of the box is 100 mL. (1 $cm^3 = 1$ mL, so 100 $cm^3 = 100$ mL.)

f. If you kept the base the same but made it large enough to hold 1 L, the base would still be 4 cm by 5 cm, but it would need a height of 50 cm (ten times higher to hold ten times as many centicubes).

6. a. The shape of a milk carton is very practical. It is easy to hold in your hand, to pour milk, and to store in the refrigerator.

b. Answers will vary. Some sample answers are given:

- milk: The carton, not including the top part, is a rectangular prism.
- pop bottle: The bottle has a round base like a cylinder.
- ketchup: Some bottles have a rectangular base. Others are round.
- juice: The cardboard carton is a rectangular prism.
- ice cream: The carton is like a cylinder. It might also be a rectangular prism.
- motor oil: The can is a cylinder. It may also have a rectangular base.
- paint: The can is a cylinder.

Challenge Activity

1. a. The volume of each JELL-O® cube is 125 cm^3. $\left(1\text{ L} = 1000\text{ cm}^3\right.$. There are 8 cubes, so each cube $= 1000\text{ cm}^3 \div 8 = 125\text{ cm}^3$.$\left.\right)$

b. The dimensions of each cube are 5 cm by 5 cm by 5 cm.

The only cube that has a volume of 125 cm^3 is a cube with dimensions of 5 cm by 5 cm by 5 cm $(5 \times 5 \times 5 = 125)$.

c. Eight cubes, each 5 cm by 5 cm by 5 cm, can be arranged in three ways using the pan sizes shown in the following table.

Length (cm)	Width (cm)	Height (cm)	Dimensions of Pan (cm)
10	10	10	10 by 10 by 11
10	20	5	10 by 20 by 6
5	40	5	5 by 40 by 6

d. Doreen would more likely have had a 10 by 20 by 6 or a 10 by 10 by 11 pan than a 5 by 40 by 6 pan. The 10 by 20 by 6 pan would be the easiest to use. The cubes would be easier to cut because they would be in a single layer.

2. a. The dimensions of the rectangular solid you can make are always (the number of centicubes on the edge of the cube) by (the number of centicubes on the edge of the cube plus 1) by (the number of centicubes on the edge of the cube minus 1).

b.

Number of Centicubes on Each Edge of the Cube	Total Number of Centicubes in the Cube	Number of Centicubes After One Row Was Removed	Dimensions of One Rectangular Solid That Can Be Made with the Remaining Centicubes
2	$2 \times 2 \times 2 = 8$	$8 - 2 = 6$	$1 \times 2 \times 3$
3	$3 \times 3 \times 3 = 27$	$27 - 3 = 24$	$2 \times 3 \times 4$
4	$4 \times 4 \times 4 = 64$	$64 - 4 = 60$	$3 \times 4 \times 5$
5	$5 \times 5 \times 5 = 125$	$125 - 5 = 120$	$4 \times 5 \times 6$
6	$6 \times 6 \times 6 = 216$	$216 - 6 = 210$	$5 \times 6 \times 7$
7	$7 \times 7 \times 7 = 343$	$343 - 7 = 336$	$6 \times 7 \times 8$
8	$8 \times 8 \times 8 = 512$	$512 - 8 = 504$	$7 \times 8 \times 9$

c. The dimensions of the rectangular solid that can be made by removing one row along the edge of a cube that has 25 centicubes is $24 \times 25 \times 26$.

The dimensions of the rectangular solid that can be made by removing one row along the edge of a cube that has 56 centicubes is $55 \times 56 \times 57$.

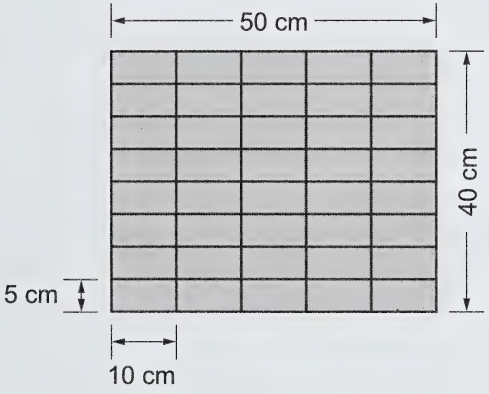
The dimensions of the rectangular solid that can be made by removing one row along the edge of a cube that has 128 centicubes is $127 \times 128 \times 129$.

Lesson 2: Mass, Volume, and Capacity

Activity 1

1. You need 10 base ten rods to make a model of one of these gold bars.

2. a.

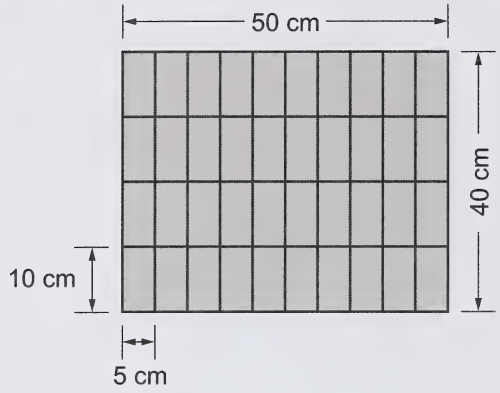


b. Forty gold bars are needed to make the bottom layer. They form a 5 by 8 array.

c. Ten such layers are needed to fill the chest. Each layer is 2 cm thick and the chest is 20 cm deep.

d. Four hundred gold bars are needed to fill the chest. There are 10 layers of 40 bars each.

3. a.



b. Forty bars are needed for the bottom layer. They form a 4 by 10 array.

c. Ten layers would fill the chest. Each layer is 2 cm thick and the chest is 20 cm deep.

d. Four hundred gold bars are needed to fill the chest. There are 10 layers of 40 bars each.

4. The same number of bars (400) is needed to fill the chest in both questions 2 and 3.

5. a. The mass of one gold bar is $2000\ \text{g} = 2\ \text{kg}$. The bars made with rods had 2 layers of 50 centicubes each, which is 100 centicubes in total.

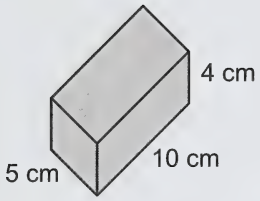
$100 \times 20\ \text{g} = 2000\ \text{g} = 2\ \text{kg}$

b. If the chest was packed full with gold bars, the total mass of the gold bars in grams is $400 \times 2000\ \text{g} = 800\ 000\ \text{g}$. The total mass of the gold bars in kilograms is $400 \times 2\ \text{kg} = 800\ \text{kg}$.

c. The total mass of the gold bars in tonnes is $\frac{800}{1000}\ \text{t} = 0.8\ \text{t}$.

d. Two sailors could not carry this chest of gold bars because it is much too heavy. It is almost as heavy as a small car!

6. a.



b. The mass of 1 silver bar is $2000\ g = 2\ kg$. It could be made of 4 layers of centicubes, with each layer being a 5 by 10 array. That makes $4 \times 50 = 200\ cm^3$. Each cubic centimeter has a mass of 10 g, so $200 \times 10\ g = 2000\ g = 2\ kg$.

c. If the same chest was packed full with silver bars, the total mass of the silver bars in grams is $200 \times 2000\ g = 400\ 000\ g$. The total mass of the silver bars in kilograms is $200 \times 2\ kg = 400\ kg$.

d. Two sailors could not carry this chest of silver bars. It is much too heavy. It is about as heavy as a motorcycle!

7. a. You would need a total of 180 base ten flats (60 piles of 3 base ten flats each) to represent a board that is 6 m long.

b. The mass of the chest is about 7.2 kg. (Each base ten flat has $100\ cm^3$. $180 \times 100\ cm^3 = 18\ 000\ cm^3$. Each cubic centimetre of oak has a mass of 0.4 g, so $18\ 000 \times 0.4\ g = 7200\ g = 7.2\ kg$.)

c. The total mass of the chest and the gold bars is 103.2 kg. (There are $2 \times 6 = 12$ gold bars in each layer. There are 4 such layers, so there is a total of $4 \times 12 = 48$ gold bars. The mass of the gold bars is $48 \times 2\ kg = 96\ kg$. The total mass of the chest and the gold bars $= 7.2\ kg + 96\ kg = 103.2\ kg$.)

d. Yes, two sailors could carry this chest of gold bars. A mass of 103.2 kg is equal to the mass of one large sailor, and two strong sailors could carry one large sailor.

e. Replace 24 gold bars with 12 silver bars.

Mass of 24 gold bars $= 24 \times 2\ kg = 48\ kg$

Mass of 12 silver bars $= 12 \times 2\ kg = 24\ kg$

The total mass of the chest and the bars $= 48\ kg + 24\ kg + 7.2\ kg = 79.2\ kg$.

8. Mass of 365 gold bars $= 365 \times 2$ kg $= 730$ kg

Mass of 240 silver bars $= 240 \times 2$ kg $= 480$ kg

The total mass of the gold and silver bars $= 730$ kg $+ 480$ kg $= 1210$ kg $= 1.21$ t.

Activity 2

1. **a.** There are 36 sugar cubes left. (The two-layer box has a mass of 500 g, so one layer has a mass of 250 g, and 125 g is the mass of half a layer. There are $144 \div 2 = 72$ cubes in one layer, so there are $72 \div 2 = 36$ sugar cubes in half a layer.)

   b. The mass of a sugar cube is about 3 g. (Estimate by thinking that 144 is about 150. 150×3 g $= 450$ g and 150×4 g $= 600$ g. 500 g is closer to 450 g, so the mass of one cube is about 3 g.)

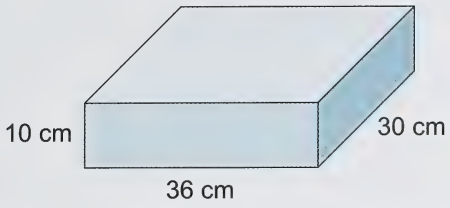
   The mass of a sugar cube is 3.5 g to the nearest tenth of a gram. (Using a calculator: $500 \div 144 = 3.472222$)

   c. You must buy 7 boxes of sugar cubes. You need 3.25 kg $= 3250$ g.

Number of Boxes of Sugar Cubes	Total Mass of Sugar Cubes (in g)
1	500
2	1000
3	1500
4	2000
5	2500
6	3000
7	3500

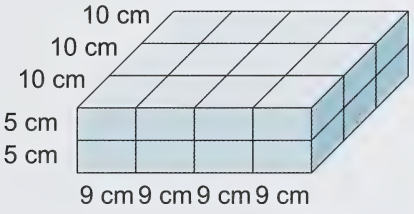
   d. There would be 288 000 sugar cubes in 1 t of sugar cubes. (In 500 g, there are 144 sugar cubes, so in 1 kg, there are $2 \times 144 = 288$ sugar cubes. 1 t $= 1000$ kg, so there are $1000 \times 288 = 288\,000$ sugar cubes in 1 t.)

2. a.

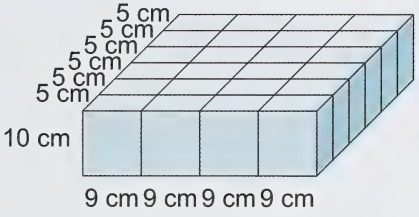


b. The storekeeper can cut 24 smaller blocks of cheese from the 12-kg block. There are two ways of doing this:

Method 1: The 36 cm by 30 cm by 10 cm block can be sliced into two layers, each 5-cm thick. Each layer can be sliced into 12 blocks (a 3 by 4 array). Each of the 24 blocks is 9 cm by 10 cm by 5 cm.



Method 2: The 36 cm by 30 cm by 10 cm block can be sliced into 24 blocks (a 4 by 6 array). Each of the 24 blocks is 5 cm by 9 cm by 10 cm.



c. The mass of each of the smaller blocks of cheese is 500 g. ($12\ \text{kg} = 12\,000\ \text{g}$. There are 24 blocks, so $12\,000\,\text{g} \div 24 = 500\ \text{g}$.)

3. a. The total cost of 200 g of ham and 300 g of chicken is $6.85.

Estimate: $2 \times \$1.50 = \$3.00$ and $3 \times \$1.30 = \$3.90$, or about $4.00.
$\$3 + \$4 = \$7$.

Calculate: $2 \times \$1.49 = \$2.98$ and $3 \times \$1.29 = \$3.87$
$\$2.98 + \$3.87 = \$6.85$

b. The cost of 0.5 kg of chicken is 65¢.

Estimate: $\$1.30 \div 2 = 50¢ + 15¢ = 65¢$

Calculate: $\$1.29 \div 2 = \$0.645$ (The cost is always rounded up to the next cent.)

c. The mass of each slice of ham is 18.75 g.

Estimate: 150 g is close to 160 g, and $160\ \text{g} \div 8 = 20\ \text{g}$

Calculate: $150\ \text{g} \div 8 = 18.75\ \text{g}$

4. The mass of each serving is 125 g.

Estimate: $1\ \text{kg} = 1000\ \text{kg}$. If ten people share 1000 g, each share will be 100 g. That means that eight people will each receive a little more than 100 g.

Calculate: $1000\ \text{g} \div 8 = 125\ \text{g}$

5. a. Estimate: If each serving is 150 g, there would be ten servings; but the servings are only 125 g, so there will be more than ten servings.

Calculate: $1500\ \text{g} \div 125\ \text{g} = 12$, so twelve 125-g servings can be cut from the cake.

b. Nine of these 1.5-kg cakes are needed so that each person can receive a 125-g serving.

Number of Cakes	Number of 125-g Servings
1	12
2	24
3	36
4	48
5	60
6	72
7	84
8	96
9	108

Note: There will be some cake left over. Use a calculator: $100 \div 12 = 8.3333333$.

6. a. The distributor can make 2500 400-g bags of grapes.

$1\ \text{t} = 1000\ \text{kg} = 1000 \times 1000\ \text{g} = 1\,000\,000\ \text{g}$

$1\,000\,000\ \text{g of grapes} \div 400\ \text{g} = 2500\ \text{bags of grapes}$

b. Each store will receive 100 bags of grapes.

$2500\ \text{bags of grapes} \div 25 = 100\ \text{bags of grapes for each store}$

Going Further

Answers will vary. A sample answer is given.

I found it harder to estimate large target masses. (It was harder to estimate 3 kg than 1 kg.) My estimates got better as I did more of them.

Activity 3

Answers will vary. The accuracy of the measures made will depend on the accuracy of the measuring instruments (measuring cups and scales), as well as the measuring process.

1. **a.** The mass of the cup is 30 g.

   b. I expect the mass to be 280 g when filled with water because the mass of 250 mL of water is 250 g and the mass of the cup is 30 g.

   $$250\ \text{g} + 30\ \text{g} = 280\ \text{g}$$

   c. I measured the mass of the cup with water to be 280 g.

   d. I can find the mass of the water in the cup by subtracting the mass of the cup from the total mass of the cup of water.

   $$280\ \text{g} - 30\ \text{g} = 250\ \text{g}$$

   e. Maybe the cup was not exactly 250 mL. (Many measuring cups have a capacity closer to 240 mL.) Maybe my scale is not accurate. Maybe I was careless in filling the cup or in reading the scale.

2. **a.**

Substance (250 mL in a measuring cup)	Prediction	Mass (g)
Flour	lighter	170
Sugar	lighter	245
Dry Cereal (e.g., corn flakes)	lighter	55
Pastas	lighter	105
Rice	lighter	230

   b. All of these substances are lighter than water.

3. It is better to give the amount of shredded cheddar cheese needed in grams than in millilitres. If you use a measuring cup to measure the cheese in millilitres, the amount of cheese you get will depend on how thickly you shred the cheese and how tightly you pack it into the cup. If you use a scale to measure the cheese in grams, the amount you get will not depend on how thickly you shred it or how tightly you pack it.

4. a.

Products Sold by Capacity (L or mL)	Products Sold by Mass (g or kg)
soup	dry cereals
juice	jelly powders
vegetable oil	tuna
vinegar	ground coffee
ketchup	cookies

b. The products sold by capacity are liquids. The products sold by mass are solids or powders.

5. a. The capacity of the box is $3000\ \text{mL} = 3\ \text{L}$.

A layer made with a 6 by 20 array of centicubes would cover the bottom of the box, and 25 layers would be needed to fill the box. Each layer $= 6 \times 20 = 120$ centicubes.

$$\text{Total centicubes in 25 layers} = 25 \times 120 = 3000 \text{ centicubes}$$

$$3000 \text{ centicubes} = 3000\ \text{cm}^3 = 3000\ \text{mL} = 3\ \text{L}$$

b. There are twelve 25-g servings of cereal in a 300-g box.

$$300\ \text{g} \div 25\ \text{g} = 12$$

c. No, you can't use the capacity of the box to find the capacity of a 25-g serving of cereal. There is empty space in the box. The manufacturer leaves some empty space at the top. The cereal also settles in the box.

Challenge Activity

Answers will vary. Sample answers are given.

Method 1

I can begin by choosing two bars. I can put one bar on the left side of the scale and put the other bar on the right side of the scale.

- If they don't balance, I know that the lighter bar is phony.
- If they balance, they are both real, so I can try a second pair from the remaining bars.
- If the second pair balance, they are both real, so I can try a third pair from the remaining bars.
- If the third pair balance, they are both real. I know that the remaining bar is phony.

Method 2

I can begin by putting three bars on each side of the scale.

- If they balance, all six bars I used are real, so I know that the remaining bar is phony.
- If they don't balance, I know that the phony bar is in the set of three that weighed lighter. All the other bars are real.
- I can choose two from the lighter set, putting one bar on the left side of the scale and the other bar on the right side of the scale.
- If they don't balance, I know that the lighter bar is phony.
- If they balance, they are both real. I know that the remaining bar is phony.

Lesson 3: Time

Activity 1

1. There were six watches in one day. $(24 \div 4 = 6)$

2. **a.** The bell is heard a total of 36 times during a 4-h watch.

$$1+2+3+4+5+6+7+8=36$$

b. A total of 216 bells are heard in one day.

$$6\times 36=216$$

3. **a.** The ship sailed 70 m in 30 s.

$$5\times 14\ \text{m}=70\ \text{m}$$

b. The ship sailed 8.4 km if it travelled at the same speed for 1 h.

$$2\times 70\ \text{m}=140\ \text{m}\ \text{ in 1 min}$$
$$60\times 140\ \text{m}=8400\ \text{m}=8.4\ \text{km}\ \text{ in 1 h}$$

4. **a.** The time is read as "twenty-one minutes past five" or "five twenty-one." The time is written as 5:21.

b. The time is read as "nine minutes past twelve" or "twelve nine." The time is written as 12:09.

c. The time is read as "twelve minutes before five" or "four forty-eight." The time is written as 4:48.

d. The time is read as "nineteen minutes past three" or "three nineteen." The time is written as 3:19.

e. The time is read as "twenty-seven minutes past eleven" or "eleven twenty-seven." The time is written as 11:27.

f. The time is read as "twenty-four minutes to eight" or "seven thirty-six." The time is rewritten as 7:36.

Activity 2

1. The problem with Patti's note to her mom is that it isn't clear if the plane will arrive in the morning or in the evening.

2. The labels A.M. and P.M. should be switched. The boy would be returning home from school at 5:30 P.M., not 5:30 A.M. The boy would be getting on the school bus at 8:00 A.M., not 8:00 P.M. The boy would be running at 3:00 P.M., not 3:00 A.M. The boy would be doing math at 10:15 A.M., not 10:15 P.M.

3.

12-h Time	24-h Time
12:00 A.M. (midnight)	00:00
1:00 A.M.	01:00
2:00 A.M.	02:00
3:00 A.M.	03:00
4:00 A.M.	04:00
5:00 A.M.	05:00
6:00 A.M.	6:00
7:00 P.M.	07:00
8:00 A.M.	08:00
9:00 A.M.	09:00
10:00 A.M.	10:00
11:00 A.M.	11:00

12-h Time	24-h Time
12:00 P.M. (noon)	12:00
1:00 P.M.	13:00
2:00 P.M.	14:00
3:00 P.M.	15:00
4:00 P.M.	16:00
5:00 P.M.	17:00
6:00 P.M.	18:00
7:00 P.M.	19:00
8:00 P.M.	20:00
9:00 P.M.	21:00
10:00 P.M.	22:00
11:00 P.M.	23:00

4. Yes, Laura's method is correct. Any given time past noon (P.M. time) is 12 h later than the matching morning (A.M.) time.

5.

Change to Be Made	12-h Time	24-h Time
3 h past 10:00 A.M.	1:00 P.M.	13:00
4 h before 11:30 A.M.	7:30 A.M.	07:30
5.5 h after 6:00 P.M.	11:30 P.M.	23:30
2 h before 15:15	1:15 P.M.	13:15
3 h 15 min after 08:45	12:00 P.M. (noon)	12:00
3.25 h past 8:45 P.M.	12:00 A.M. (midnight)	0:00
12 h before 16:10	4:10 A.M.	04:10

6. The parade lasted 5 h 20 min. Solution strategies will vary. Sample methods are given.

Method 1: Counting ahead

5 h from 9:20 A.M. is 14:20 P.M.; and another 20 min is 14:40 P.M. Therefore, the length of time is $5\ \text{h} + 20\ \text{min} = 5\ \text{h}\ 20\ \text{min}$.

Method 2: Subtracting 24-h time

End time	14:40 =	14 h 40 min
Start time	09:20 =	− 9 h 20 min
Length of time		5 h 20 min

7. The hot-air balloon trip lasted 7 h 30 min or 7.5 h. Solution strategies will vary. Sample methods are given.

Method 1: Counting ahead

4 h from 8:20 A.M. is 12:20 P.M.; and another 3 h makes 3:20 P.M.; and another 30 min is 3:50 P.M.

Therefore, the length of time is $4\ \text{h} + 3\ \text{h} + 30\ \text{min} = 7\ \text{h}\ 30\ \text{min}$ or 7.5 h.

Method 2: Subtracting 24-h time

End time	3:50 P.M. =	15:50 =	15 h 50 min
Start time	8:20 A.M. =	08:20 =	− 8 h 20 min
Length of time			7 h 30 min = 7.5 h

8. Deepti has 4 h 30 min or 4.5 h until take-off. Solution strategies will vary. Sample methods are given.

Method 1: Counting ahead

18:45 is the same as 6:45 **P.M.**

4 h after 2:15 **P.M.** is 6:15 **P.M.**; and another 30 min is 6:45 **P.M.** Therefore, the length of time is $4\text{ h} + 30\text{ min} = 4\text{ h }30\text{ min} = 4.5\text{ h}$.

Method 2: Subtracting 24-h time

Take-off time	18:45	= 18:45 =	18 h 45 min
Present time	2:15 **P.M.**	= 14:15 =	− 14 h 15 min
Time until take-off			4 h 30 min = 4.5 h

9. a.

Person's Name	Starting Time (Logged On)	Ending Time (Logged Off)	Length of Time
Raoul	11:00	18:00	7 h
Janine	8:00 A.M.	3:00 P.M.	7 h
Sid	06:30	14:30	8 h
Victoria	4:30 P.M.	8:30 P.M.	4 h
Sasha	16:30	20:15	3 h 45 min
Yasmin	10:45 A.M.	3:15 P.M.	4 h 30 min

b. Answers will vary. A sample answer is given.

If the starting time is in the morning and the ending time is in the afternoon, then I find it harder with 12-h notation because I need to find the amount of time before noon that you started and add this to the amount of time past noon that you ended.

Activity 3

1. Both the date and the time are written in order, from the largest unit to the smallest unit.

2.

SI Notation	Description of the Date and 12-h Time
2003-04-02 20:05	8:05 P.M. on April 2, 2003
1989-01-31 01:31	1:31 A.M. on January 31, 1989
1991-09-19 17:45	5:45 P.M. on September 19, 1991
1992-08-01 05:16	5:16 A.M. on August 1, 1992
2001-01-08 16:05	4:05 A.M. on January 8, 2001
1996-06-29 23:05	11:05 P.M. on June 29, 1996
1998-06-24 00:00	12:00 A.M. (midnight) on June 24, 1998
2002-02-02 02:02	2:02 A.M. on February 2, 2002

3. Garry must wait for 2 months and 8 days.

4. **a.** Suzie's tenth birthday is on 2003-08-29.
   b. Suzie was born on 1993-08-29.

5. The date is 2002-10-04.

6. The date and time was October 31, 1777, at 12:40 **P.M.**

Challenge Activity

The actual time will be 19:00.

Use a table to compare the actual time with the time on each of the two clocks.

Actual Time	Fast Clock (gained 10 min every hour)	Slow Clock (lost 5 min every hour)
11:00	11:00	11:00
12:00	12:10	11:55
13:00	13:20	12:50
14:00	14:30	13:45
15:00	15:40	14:40
16:00	16:50	15:35
17:00	18:00	16:30
18:00	19:10	17:25
19:00	20:20	18:20

Keystrokes

1. August 1, 1992 = 1992-08-01

Keystrokes	92	÷	4	=	+	92	=	+	1	=	+	2	÷	7	=
Display	92	92	4	23	23	92	115	115	1	116	116	2	118	7	16.857142

Find the remainder: $16 \times 7 = 112$ and $118 - 112 = 6$. Use the table on the bottom of page 59 to find the day of the week.

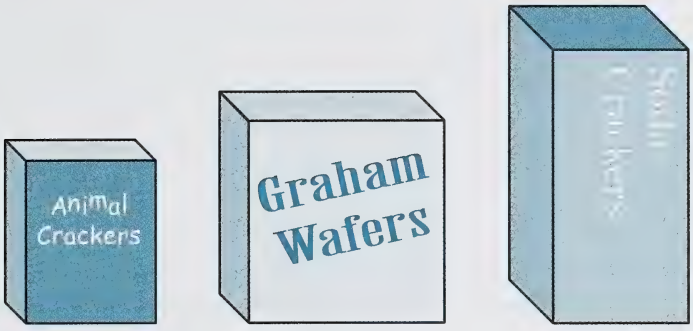
1992-08-01 was a Saturday.

2. Answers will vary.

Review

1. a. Answers will vary. Sample answers are given.

Estimate	Estimate	Estimate
$= 1000\ cm^3$	$= 2000\ cm^3$	$= 2500\ cm^3$



b. To check my estimates with centicubes, I could fill each box with layers of centicubes and count how many each box holds.

To check my estimates with a ruler, I could do the following:

- Measure the width of the box top or bottom to find out how many rows of centicubes would be in one layer.
- Measure the length of the box top or bottom to find out how many centicubes would be in each row.
- Multiply the number of rows times the number of centicubes in each row to find out how many centicubes would be in one layer.
- Measure the height of the box to find out how many layers would fit in the box.
- Multiply the number of layers times the number of centicubes in each layer to find out how many centicubes would fit in the box.

The results are shown in the following table.

	Length (cm)	Width (cm)	Height (cm)	Volume (cm^3)
Animal Crackers	14	5.5	18.5	1424.5
Graham	19.5	6	20.5	2398.5
Soda Crackers	11	11	24	2904

The three boxes were ordered correctly.

2. a. Textbook, page 256, Practise Your Skills, questions 1, 2, and 3

1. Box B has the greater volume.

Box A can be filled with 3 layers of centicubes. Each layer has 120 centicubes (a 4 by 30 array).

$$3 \times 120 = 360 \text{ cm}^3$$

Box B can be filled with 9 layers of centicubes. Each layer has 45 centicubes (a 5 by 9 array).

$$9 \times 45 = 405 \text{ cm}^3$$

2. Box C has the greater volume.

Box C can be filled with 20 layers of centicubes. Each layer has 50 centicubes (a 5 by 10 array).

$$20 \times 50 = 1000 \text{ cm}^3$$

Box D can be filled with 8 layers of centicubes. Each layer has 120 centicubes (an 8 by 15 array).

$$8 \times 120 = 960 \text{ cm}^3$$

3. Box E and Box F have equal volumes.

   Box E can be filled with 8 layers of centicubes. Each layer has 42 centicubes (a 6 by 7 array).

   $8 \times 42 = 336 \text{ cm}^3$

   Box F can be filled with 6 layers of centicubes. Each layer has 56 centicubes (a 7 by 8 array).

   $6 \times 56 = 336 \text{ cm}^3$

b. Box C is the only box that has a capacity of 1 L. Its volume is 1000 cm^3.

$1 \text{ cm}^3 = 1 \text{ mL}$, so $1000 \text{ cm}^3 = 1000 \text{ mL} = 1 \text{ L}$

3. Textbook, page 252, Practise Your Skills, questions 1 and 2

1. The yellow building has 30 cubes. It has 2 layers of cubes, and each layer has 15 cubes (a 3 by 5 array).

   $2 \times 15 = 30$ cubes

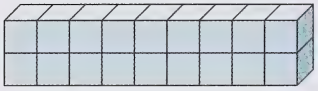
2. The blue building has 48 cubes. It has 6 layers of cubes, and each layer has 8 cubes (a 2 by 4 array).

   $6 \times 8 = 48$ cubes

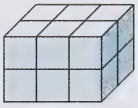
4. Textbook, page 264, Skill Bank from This Unit, questions 2, 4, and 5

2. You can make four boxes that hold exactly 18 cubes.

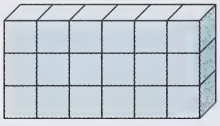
18 long by 1 wide by 1 tall



9 long by 1 wide by 2 tall



3 long by 2 wide by 2 tall



6 long by 1 wide by 3 tall

4. a. The volume of the purple box is 1200 cm^3. It can hold 15 layers of centicubes, and each layer has 80 centicubes (an 8 by 10 array).

$$15 \times 80 = 1200 \text{ cm}^3$$

b. The volume of the blue box is 5000 cm^3. It can hold 20 layers of centicubes, and each layer has 250 centicubes (a 10 by 25 array).

$$20 \times 250 = 5000 \text{ cm}^3$$

5. The dimensions of the box might be 4 cm by 1 cm by 15 cm or 4 cm by 3 cm by 5 cm.

5. a. The mass of the gold bar $= 800 \text{ g} = 0.8 \text{ kg}$.

2 layers of 20 centicubes $= 2 \times 20 \text{ cm}^3 = 40 \text{ cm}^3$

$40 \times 20 \text{ g} = 800 \text{ g}$

b. There would be 1250 of these gold bars in 1 t.

$1 \text{ t} = 1000 \text{ kg} = 1\,000\,000 \text{ g}$

$1\,000\,000 \text{ g} \div 800 \text{ g} = 1250$

6. You would need 3.6 kg of hamburger.

$3 \text{ dozen hamburgers} = 3 \times 12 = 36 \text{ hamburgers}$
$36 \times 100 \text{ g} = 3600 \text{ g} = 3.6 \text{ kg}$

7. The mass of the bottle of water is 391 g. 1 mL of water has a mass of 1 g, so 341 mL of water have a mass of 341 g.

$341 \text{ g} + 50 \text{ g} = 391 \text{ g}$

8. a. The mass of one link is 12.5 g. $525 \text{ g} \div 42 = 12.5 \text{ g}$.

b. There would be 80 links in a 1-kg chain.

$1 \text{ kg} = 1000 \text{ g}$
$1000 \text{ g} \div 12.5 \text{ g} = 80$

9. Sixteen of these sandwiches can be made from 1.2 kg of shaved ham.

$1.2 \text{ kg} = 1200 \text{ g}$
$1200 \text{ g} \div 75 \text{ g} = 16$

10. You could use a kitchen scale to measure 275 g of water. 1 mL of water has a mass of 1 g, so 275 mL of water have a mass of 275 g.

11.

Description of Time	12-h Time	24-h Time
10 min past 13:25	1:35 P.M.	13:35
5 min before 12:00 noon	11:55 A.M.	11:55
2 h after 22:55	12:55 A.M.	00:55
4 h 10 min before 9:16 P.M.	5:06 P.M.	17:06
1 second past midnight	12:00:01 A.M.	00:00:01

12. The date of Donna's tenth birthday is 2005-03-29.

13. The date and time of sunrise was 2000-12-18 08:47.

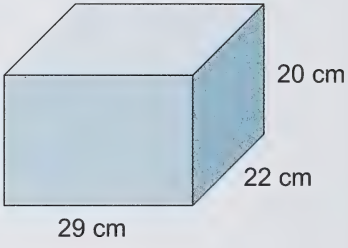
14. **a.** 3:45 P.M. or 15:45
b. 5:47 A.M. or 5:47
c. 12:03 A.M. or 00:03

15. **a.** 1999-11-15 07:55
b. 2020-05-30 20:15

16. Textbook, page 262, Problem Bank, questions 1 and 3

1. Answers will vary. A sample answer is given.

a. One way to arrange the books is to make a pile of 10 books. Each book is 28.3 cm long by 21.5 cm wide by 1.9 cm high. To allow some packing space, I rounded all the dimensions up to the next whole centimetre: 29 cm by 22 cm by 2 cm. A pile of books is $10 \text{ cm} \times 2 \text{ cm} = 20 \text{ cm}$ high.



b. A box for 15 copies of the book could be 29 cm long by 22 cm wide by 30 cm high. The length and width could be the same as the box for 10 books, but it would be 10 cm higher $(5 \times 2 \text{ cm} = 10 \text{ cm})$.

3. **a.** Other number of cubes that can fit in only one box are 13 cubes, 17 cubes, and 19 cubes. Only one array can be made with each of these numbers because they are prime numbers.

b. Fourteen cubes and 15 cubes can fit in two types of boxes:

- Fourteen cubes can be put in a 1 by 1 by 14 box or a 1 by 2 by 7 box.
- Fifteen cubes can be put in a 1 by 1 by 15 box or a 1 by 3 by 5 box.

Twelve cubes, 16 cubes, and 18 cubes can fit in more than two types of boxes:

- Twelve cubes can be put in a 1 by 1 by 12 box, a 1 by 2 by 6 box, a 1 by 3 by 4 box, or a 2 by 2 by 3 box.
- Eighteen cubes can be put in a 1 by 1 by 18 box, a 1 by 2 by 9 box, a 1 by 3 by 6 box, or a 2 by 3 by 3 box.

17. Textbook, page 264, Skill Bank from This Unit, question 5

The dimensions of the box might be $3 \times 4 \times 5$. (If the box holds 60 centimetre cubes and one dimension is 4 cm, there might be 4 layers of 15 cubes. Each layer might be a 3×5 array of cubes.)

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